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ABSTRACT

This report documents the long term cost benefits to society of the Self Controlled Interactive Learning Systems (SCILS), a program based on cybernetics and designed to teach early reading skills to children ages 3 to 6. SCILS required children to spend not more than 20 minutes daily using a "talking typewriter," a "talking page," and a "voice mirror" to practice letter recognition, typing letters from dictations, and reading words aloud. Teachers also worked with children on individual experience stories. The major assumptions of the cost benefit analysis were that documented high reading achievement in fifth grade for subjects who completed at least 30 hours of SCILS would continue and that none of them would be functionally illiterate or drop out before completing high school. The first chapter of the report extensively reviews the benefits to the United States and other countries of investing in preschool, primary, secondary, and postsecondary education, both for the advantaged and for those disadvantaged by gender or race. The next chapter describes the cost benefit analysis used in the study. Benefits to individuals were calculated in terms of individual differential lifetime earnings, and social benefits were calculated in terms of increases in the gross national product. Costs included those incurred by providing more high school education and by offering the SCILS system. Findings indicate an eight-to-one return on investment in SCILS for the individual and a two-to-one return for society. Other findings include: (1) regardless of initial IQ, children who had 10 or more hours of SCILS achieved at or above grade level in reading skills and children who had 30 or more hours of SCILS achieved at or above grade in reading comprehension and arithmetic; (2) For children in SCILS, IQ did not predict achievement; (3) achievement was sustained beyond grade three; and (4) there is a positive correlation of time in SCILS with achievement that increases as children go through school. The last chapter presents a longitudinal data analysis of the reading achievement of children participating in SCILS. (CB)

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SUMMARY: THE COST-BENEFIT ANALYSIS SHOWS BENEFICIAL RETURN ON INVESTMENT IN SCILS FOR THE INDIVIDUAL (8:1) AND SOCIETY (2:1).

COST - BENEFIT ANALYSIS OF SCILS

FOR EARLY CHILDHOOD TRAINING

IN ACADEMIC ACHIEVEMENT

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COST-BENEFIT ANALYSIS OF SCILS FOR EARLY CHILDHOOD TRAINING IN ACADEMIC ACHIEVEMENT

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Cost-Benefit Analysis of SCILS For Early Childhood Training In Academic Achievements

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SUMMARY

The SCILS* program was a communication (cybernetic) program in education, developed analytically in 1962 as part of the doctoral dissertation** on "A Philosophical and Cybernetic Model of Thinking", as well as in later studies [1, 2. 3, 4, 5, 6, 7, 8, 9, 10].

The empirical development of SCILS at the Early Childhood Center (Drexel University) dates from January 1967 and is still continuing.

The cost-benefit analysis follows as a way of gauging the financial costs and educational and economic benefits of the use of technology in education.

Scholars are in unanimous agreement that the greatest benefit for any nation from education, whether the nation be developing or developed, comes from primary education. It is also thought, although not yet unequivocally demonstrated, that the benefits may be even greater from "pre-school" education.

The following cost-benefit study indicates that the individual economic cost-benefit ratio is eight to one for both sexes and races. This is an eight to one return or investment for the individual. The social benefit-cost ratio is two to one. This is a two to one return on investment for society. These figures arise from the most conservative assumptions employed in the several analyses.

* SCILS = Self Controlled Interactive Learning Systems
** Ph.D., University of Pennsylvania

REFERENCES

[1] Steg, D.R., "Programmed Teaching and Learning", in Villemain, F.T. (Ed.). Proceedings of Philosophy of Education Society. Chicago, Illinois: Southern Illinois University. Edwardsville, Illinois. May, 1963.

[2] Steg, D.R., "Some Aspects of Teaching and Learning", in Villemain, F.T. (Ed.), Proceedings of Philosophy of Education Society: 132-139, Chicago, Illinois: Southern Illinois University, Edwardsville, Illinois, May, 1964.

[3] Steg, D.R., "System Rules and Ethics", in Villemain, F.T. (Ed.), Proceedings of Philosophy of Education Society: 20-25, Chicago, Illinois, Southern Illinois University, Edwardsville Illinois, 1966.

[4] Steg, D.R. and D'Annunzio, A., "Some Theoretical and Experimental Considerations of Responsive Environments, Learning and Social Development", in Rose, J. (Ed.), Progress of Cybernetics, Volume 3: 1145-1161. New York: Gordon and Breach Science Publishers. 1970.

[5] Steg, D.R. "A Philosophical and Cybernetic Model of Thinking, or a Feedback Analog to Thinking and Other Consequences", in Scandura, J., Durnin, J. and Wulfeck II, W. (Eds.), Proceedings of the Society for Sturctural Learning: Philadelphia, Pennsylvania, University of Pennsylvania, April, 1973.

[6] Steg, D.R. and Schulman, R., "A General Theory of Adapting Behavior", VIIth Internation Congress on Cybernetics: 831-843, Namur: Association Internationale de Cybernetique, 1973.

[7] Steg, D.R. and Schulman, R., "An Interdisciplinary Theory of Adapting Behavior" Office of Naval Research Technical Report, NR 151-356X: 274-289. September, 1974.

[8] Steg, D.R., D'Annunzio, A. and Fox C., "Deviation-Amplifying Processes and Individual Human Growth and Behavior", in Rose, J. (Ed.), Advances in Cybernetics and Systems: 1646-1665, New York: Gordon and Breach, 1975

[9] Steg, D.R., "Cybernetics Revisited", Frontiers of Strategic Management Internation Conference TIMS/ORSA (The Internation Management Science and Operations Research Society of America). Americana Hotel, New York, N.Y., May 1, 1978.

[10] Steg, D.R. and Schulman, R., "Human Transaction and Adapting Behavior" in K. Krippendorff (Ed.), Communication and Control in Society, New York: Gordon and Breach Science Publishers, 1979.

SCILS* - SOME EXEMPLARY FINDINGS AT DREXEL ECC

- Time on Task: All children, regardless of initial IQ, who had 10 hours or more of instructional time in SCILS, are achieving at or above grade level in reading skills (Wide Range Reading Test).

  All children, regardless of initial IQ, who received 30 hours or more of instructional time in SCILS, are also achieving at or above grade level in reading comprehension and arithmetic (Spache Diagnostic Reading Scales and Wide Range Arithmetic Test).

- IQ and Achievement: For the children in SCILS, initial IQ measures do not predict achievement. There is no correlation between initial IQ and achievement in reading.

- Achievement gains are sustained beyond the third grade. Nationally, high risk low SES (Socio-Economic Status) children show a decrease in achievement test scores after third grade. This is not the case with high risk low SES children who experienced the SCILS program.

- The positive correlation of time on SCILS with achievement increases as the children go through school.

- Case studies indicate that even young children with the most difficult behavior problems can maintain continuing progress after participation in SCILS.

- Cost of Program: The individual economic cost-benefit ratio is eight to one for both sexes and races. This is an eight to one return on investment for the individual. The social-benefit-cost ratio is two to one. This is a two to one return on investment for society.

* Self-Controlled Interactive Learning Systems

INTRODUCTION

The estimation of probable future benefits to individuals and society of present investment in education, whether primary, secondary or higher, has occupied economists for quite a number of years. Many methods have been attempted to estimate possible present value of future earnings, "opportunity cost"—time lost presently against dollars gained in the future, etc., and have yielded a tremendous volume of literature. Among the more controversial theoretical problems of measurement are those which deal with assessing social benefits—benefits to society from better performance on the part of working individuals—or from improved efficiency on the part of the total work force. This, in spite of the fact that the definition of "cost", is by no means the subject of universal agreement.

Therefore, the first part of this study will contain a resumé of the literature. If some of the digests are well known to the reader other findings might not have been noted. The second part of this paper will deal with estimation of the costs of the SCILS program and of probable future values to the individual and to society, arising from teaching children by these techniques, during their future working lives.

The latter point presents a theoretical problem. Most of the students in the longitudinal survey are "educationally deprived" students in need of remedial work, members of the potential population of future functionally illiterate unemployables, low income, black and "educationally underprivileged". The main question, therefore, is how can we distinguish the benefits to the individual and to society of these children receiving "pre-school" training which would allow them to take their place in the main stream of American life; versus their receiving no special training and joining dropouts from this main stream, employed only during economic upturns and frittering their

lives away either on welfare or "on the street", in illegal occupations?

In order to do any cost-benefit analysis a number of assumptions had to be made concerning what might happen to these children in their future lives. Many of these assumptions could be based upon readily available statistical evidence, such as mortality rates, illness incidence, possibility or probability of accident, etc. Apart from this, the basic assumption, which may be controversial, but which is presently being borne out by longitudinal studies of the same children as they progressed in grade school, is that as a result of the intervention these children would not only be functionally literate but would successfully graduate from high school, contrary to the prediction of their initial IQ scores. They would not as otherwise anticipated, become high school drop-outs because of functional illiteracy. The presumption of the achievement of adult functional literacy by these children is adequately documented by statistical analysis of their experience in grade school, where all of them are reading at independent levels. (This can be seen in chapter 3 and in the various reports to the van Leer Foundation by Steg, et al. [1; 3; 4]). Once the assumption of functional literacy is made, children can then be predicted to be, in their adult years, members of the mainstream of the American labor force and from available statistical evidence certain other likely conclusions can be drawn.

It is fairly simple to estimate future earnings of an individual reduced to present value, and the differential between the present value of these future earnings and the present value of the earnings they would have had if they had not been part of the labor force majority. In other words, the present value of differential earnings between high school graduates and non-high school graduates could be postulated as an individual return to the SCILS program. It is possible to estimate present value of differential

periods of unemployment expected for high school and non-high school graduates. This diminution in loss of earnings can also be accepted as an individual return to the SCILS program.

However, when measuring social benefits from early school training ensuring functional literacy, some other techniques had to be found. The simplest measurements of social benefits arise from use of the multiplier and differential taxes which will accrue to government. For the present value of the multiplier, an annual U.S. average of 2 is used (for every differential dollar earned by the individual, an additional dollar will be added to Gross National Product). For the present value of differential taxes, a ratio of total taxes paid by individuals to personal income (shown by GNP accounts) is used. This includes Social Security contributions in total taxes paid, and covers all other Federal, State and local taxes.

For other societal benefits, it is much easier to measure a fever due to an illness than it is to measure the extent of good health. The fever is an aberration from the norm, whereas good health comprises all the attributes and data which go to make up the normal condition. It is much easier to measure any aberration from the norm than it is to measure the norm itself. For example, part of the societal benefit for the individuals getting training in SCILS would be the fact that they may be expected to be on welfare only at the average welfare incidence and not to be in the class which is normally always on welfare. Therefore, if society does not have to pay welfare to these individuals more than that paid to the average work force the difference will be a social benefit. The reduction of societal expenditure is as much a social benefit as is the contribution of the labor of the individual concerned.

In 1976, Schulman and Steg established a possible method of evaluating

restrictions and constrictions on individual decision-making, and suggested a technique by which this evaluation could be achieved. [2] This technique was in effect a measure of deviations from the norm, and separation of these deviations into an index of concordance. The measure of deviations from the norm, that is the quantification of negatives, instead of positives, lends itself to a number of measurements which would otherwise not be possible. For example, how much less money will society have to pay for jails? How much less money will society have to spend for welfare, hospitalization, food stamps, etc.?

It is not the intention of this paper to present anything as comprehensive and complex as the Chombard De Loeuwes index of social welfare. It will merely be the intention to attack the problem of specificity of negative attributes which can be quantified and therefore measured. Some societal gains, of course, cannot be measured and in this case it may be necessary to use (where justified by other studies) estimates.

Above all, it is the intention of this study, where probability or possibility of bias exists, to make sure that the statistics are biased on the low side and not on the high. Judging from the data available from the United States Department of Commerce, a low bias will present such a positive picture of benefits as opposed to costs that "padding" will be unneccessary. Also, judging from the work of Blaug and others on underdeveloped countries, the importance of primary education to the economic development of a country is of such preeminent character, over and above secondary and higher education, that even benefit estimates biased on the low side will vastly outweigh present costs for SCILS training.

SCILS is a technique which is eminently suitable for less developed countries because of its possible integration with the work place. Since

machinery must be serviced, the obvious spot for SCILS equipment location is where service personnel are available, and in less developed countries the availability of service personnel is usually only connected with the workplace. Therefore the equipment might be used both by "pre-school", school children and by members of the work force. SCILS could be adapted for work force training particularly in such areas as reading instructions, blueprints or invoices, and any of the myriad reading or computational skills required in manufacturing establishment.

REFERENCES

[1] Schulman, R. and Rudderow, T.J.: "Preliminary Results: Relationship Between SCILS Time and Achievement Scores". (Mimeo, Philadelphia: Drexel University, February 1978). (See Chapter 3)

[2] Schulman, R. and Steg, D.R.: "Societal Boundaries on Cybernetic Action or Decision-Making". (Namur: VIII International Congress, International Association for Cybernetics, 1976).

[3] Steg, D.R., et. al.: Early Intervention Through Technology: An Interim Report, 1975-1976. (Philadelphia: Drexel, 1976)

[4] Steg, D.R., et. al.: Early Intervention Through Technology: Report 1976-1977. (Philadelphia: Drexel, 1977).

Chapter 1
REVIEW OF LITERATURE

Since Adam Smith, economists have expressed many views concerning the relationship between education and economy. Marshall, in his Principles of Economics, discussed education as a national investment and actually presented a mathematical procedure for calculating the returns to education. Ever since the pioneering work of Miller, elaboration has continued of the relationship of education, whether general or special, with income differentials.

It is almost impossible, even in an entire volume, to list all of the authors and titles of works on the economics of education during the past two decades. It is more impossible to cover the entire field in a precis, despite restriction to the parameters of the present investigation. Consequently, only "landmark" or directly pertinent and controversial studies have been included in this literature review, and the latest work has been stressed.

One main problem in estimation of the costs of education, the conflict between those who would and those who would not consider foregone earnings in the cost estimate is no concern of this analysis. [37;45] Since there are no foregone employment earnings possible for pre-school children, this controversy does not have to be joined, and cost does not have to be estimated based upon foregone earnings. However, if SCILS were to be used for industrial training, foregone earnings would definitely have to be considered as part of the cost of SCILS, unless the training were carried on during an employee's non-earning hours.

Cost-benefit analysis in itself is anything but a new tool. In 1936, as part of a flood control project authorization, Congress formally established

cost benefit analysis as a requirement.

The exact form of the cost-benefit analysis presently used will be discussed in Chapter 2 of this report.

Early studies of the importance of education stressed the benefits reaped by a total society for increasing the general educational level of an individual or a people. The pioneering work of Miller, of the United States Census Bureau [28; 29], on income differentials by education, type of work and race, established the norm for the United States in the relationship of national and individual income to education. Miller specifically showed that the rate of mean national income from 1940 to 1960 was positively related to the quality and quantity of education. During the 1960's, the most rapid income gains for both whites and non-whites were made by those in higher educational classes [29]. The increase in annual and lifetime income with increasing education was found to be substantial and persisted for three Censuses, for which data were available, 1940, 1950 and 1960. High school graduates earned 70 to 80 percent more than elementary school graduates of comparable ages, while college graduates earned 50 to 75 percent more than high school graduates. Not only did better educated people earn more initially, but their peak earnings were higher in relation to their initial earnings. The differential in earnings associated with education remained fairly stable between 1939 and 1959 despite a rising educational level for the population and an increasing labor force. Much of the relationship between education and income was found to be a reflection of the occupations people entered. Occupations that generally required a higher level of education for entry also tended to command higher incomes [13].

The study of inequalities in personal income distribution has consumed a great deal of time and work in economic literature. "Human capital" theory,

started at the same time as scientific economics, when Adam Smith noted that wages vary with a cost of learning the business or trade (as exemplified by Schultz, Blaug, Denison) was supplanted in the 1960's by a human investment and growth theory and in the 1970's by an income distribution analysis [34].

Many of the other theories of differential income distribution do not particularly apply to the present analysis of the cost-benefit supplemental remedial education for the pre-school child.

The ability theory, which is among the oldest of all theories of personal income distribution (Adam Smith and the mercantilists), actually arose from the doctrine of the non-competing group in the labor market. In the later work of Stiglitz and Arrow, ability as measured by the prevailing intelligence tests is considered only a component of a multifaceted ability. In addition, as many economists have pointed out, ability may be used by employers as a screening device, instead of testing for the job, in order to reduce hiring costs, substituting a school diploma for a measure of ability [4]]. The filtration theory of the positive relationship between education and productivity is largely due to a conception of the role of education as a "screening" device, reflecting a set of attitudes, abilities and social background characteristics. Even if this theory is accepted, and employers do use diplomas or certificates instead of employment tests, isolation of the "selection" role of education still leaves the analyst with many other factors covarying with ability. The problem of identifiability remains.

The basic quandary which arises in any discussion of early childhood education or pre-school remediation is: how does one know the ability of the child prior to the time that ability is allowed to develop? Therefore, in the discussion of the costs and benefits of SCILS, we take the position that true

ability cannot be measured but is simply what the child is able to do. The important result is the focus on the development of the child to the fullest extent of that child's possibilities.

Individual choice theory, which is a model of an individual optimizing his income differential according to informed choice, may be regarded as a precursor of the modern human capital theory [34,9]. However, theories of individual choice, risk preference, or choice among opportunities yielding different combinations of cash income and of non-pecuniary advantages or different profiles of cash income over time, or presume the ability of the individual to choose. This theoritical orientation would become important in an analysis of the economic cost-benefit of higher education, where the adult individual ostensibly has the reasoning and logical capacity to make a rational choice, and given correct information, should make that choice which would yield to him or her the highest total utility (e.g. Pareto). For analysis of learning remediation for 3 to 8 year old children, it would seem that individual choice theory would have little positive advantage, because it also embraces the probability of proper choice for future possible alternatives. Applied to the parents of the children, the theory of individual choice of the parent for the child may be important. For example, educated parents, who have been found to be an important determinant of the ability and the educability of the children, may make a different choice from uneducated parents [17;32].

Some later econometric work on the inter-relationship between ability and education as one cause of income differentials, had suggested that the drop for the

coefficient of education which Denison placed at about 40% in 1962 [11], and Griliches and Mason placed at 10% in 1972 [18] would be much lower, perhaps about 10%. Some later work of Cardell and Hopkins appearing in the Journal of Political Economy in 1977, [6] found Griliches and Mason's conclusions to be unconvincing and, using their own data (from Griliches' earlier article), made a case which was more favorable to Denison than to the estimation of the lower bias. Denison had found that the proportional bias in the coefficient of education due to the omission of ability was approximately 40%.

HUMAN CAPITAL THEORY

There have been many objections to the human capital theory, one being that discounted value maximization behavior is too far fetched. Acccording to this criticism, lifetime earnings considerations do play a part in individual choices. But, the permanent earnings concept and the maximization of discounted lifetime earnings at uniform discount rates is unrealistic.

Whether or not this be true, and there are as many empirical evidences on one side as on the other, it would make no difference in calculation of probable individual and/or social benefits and cost derived by increasing the investment in remedial "pre-school" education. The reason this would not make a difference is that when society decides to invest, it should efficiently, utilize a discounted lifetime earning application and a cost-benefit procedure. Therefore, whether or not the discounted value maximization procedure or differential starting salaries should be used, is important for considering investment in higher education but not for investment in "pre-school" education.

The second objection, that the theory does not analyze the sources of the causes of human investment, is more or less controverted by the work of Taubman and Bowles [43,5].

Taubman estimates the contribution of different environment to sets of twins to be 46% for a linear regression of earnings and 24% for years of schooling. Making a number of assumptions, he partitions the remaining variance, that to the linear regression of earnings to 18 to 41% due to genetics and 8 to 15% to common environment, with a co-variance between genetics and environment accounting for the remainder. For years of schooling the ratio were about 40% and 30%.

He found that, given the environmental variation that existed in the cohorts under study, a substantial portion of the variance of earnings was determined prior to entry into the labor market, thus was environment and education. The major determinants of earnings found by Taubman, therefore, are family environment, ability and formal education.

The Taubman study was a direct corraboration of Bowles' work. Bowles found that the social background of individuals was shown to exercise a relatively minor impact on the number of years of schooling attained. Measures of parents, educational and occupational status seemed to explain only between a quarter and a third of the variance in years of schooling attained. "Further, the same studies seem to show that additional schooling exerts a major effect upon earnings or occupational status, independent of the social class background of the individual". [5,S220] This seems to lay to rest a common objection to the earnings function, that the apparently large impact of schooling upon earnings might be a statistical fluke resulting from the positive correlation between social class background and the level of schooling of individuals. In Bowles' study he found that, for white males, 25 to 34 years old, each additional year of schooling appeared to result in around $350 additional annual income. The educational system in the United States was a major vehicle "for transmission of economic status from one generation to the next". [5,4340]

Another objection to the human capital theory is, of course, the fact that it is partial at this present point. Even though there have been some "pre-school" investment studies and many people are presently working in the area, the human capital theory has not as yet integrated "pre-school" and informal investment into a complete theory. [34,17]

The major objection to the fact that schooling is merely a screening device can be found specifically in the theories that range from holding that schooling is a signaling device for prospective employers [39] to the theory that education plays an important role in reinforcing class structure in income inequality.

Then, there are the other theories that emphasize on the job training, holding that generalized education influences the potential productivity of the working force but that actual productivity depends upon job training and experience.

As an input into the production process, education of the labor force may be considered in the light of a capital investment. In this light, the improvement of the quality of the person as a productive agent has interested economists for many years. The first widely recognized evidence of the importance of other sources of economic growth than physical capital investment, came from work for the National Bureau of Economic Research by Kendrick. He reported that total factor productivity in the U.S. private domestic economy rose at an average rate of 1.75%. This accounted for more than one-half the 3.3% average rate of growth in real products.

In Kendrick's latest analysis he conclusively proved that the investment in education is one of the major inputs into the economic growth of the United States [25]. He pointed out that the consumption of goods as such is taking a smaller, while capital investment is taking a larger, portion of changes in income. The

conventional measures of human and physical capital formation indicated a significant rise in the proportion of income and production saved and invested, between 1929 and 1969. The ratio of net investment to Net National Products rose from near 21% to almost 31% over the 40 year period. The rise in growth investment was due to a sharp increase devoted to intangible investment between 1948 and 1969, when the ratio of intangible to tangible investment almost doubled. The tangible investment proportion remained constant while the cost of raising human beings proportionately declined. The largest proportionate increase in intangible investment came in research and development. The share of Gross National Product devoted to education and training (the largest of the intangibles) rose by 80% while the health and safety investment ratio increased by half.

Kendrick found that "...of the 1.7% annual increase in tangible capital productivity (exactly half of the overall economic growth rate in the business economy), the relative growth of real intangible capital accounted for more than 40%. The proportion was a bit larger in the 1948-1969 sub-period" [25,131]. The growth of the real capital investment could not account for all of the growth in real product in recent decades, so the gross rate of return on human capital was above that of non-human capital throughout the period. It stood at 11.7% for gross rate of return on human capital in both 1929 and 1969, compared with 9.2% in 1929 and 9.9% in 1969 for non-human capital, for the 40 year span.

For the study, Kendrick divided investment into tangible (investment structures and inventory, equipment and other durable goods) and intangible investment. He figured the latter on both a gross and net basis because of the significantly higher rate of increase of the intangible deflators. Even in constant dollars, he noted a tremendous expansion in intangible investments, "Among the various types of intangible investment, by far the most important category is education and training,

which comprises 2/3 of the total on a gross basis and over 90% on a net basis, in 1929, and a bit less in 1969. The net proportion is higher because the average life of educational investment is much longer than other types of intangible investment except health. The ratio of educational and training investment GNP increased by almost 80% on a gross basis and more than doubled on the net basis" [25,73].

Kendrick's Table 3-4 shows the percentage distribution of total gross and net investment by type, and it should be noted investment contributed almost as much, if not more, to total growth of Gross National Product than non-human or tangible investments. Kendrick shows that "We have underestimated the contribution of intangible capital formation to productivity advance and thus to economic growth in the United States. ... Further the marginal productivity and rate of return to intangible capital may be higher than for tangible capital" [25,116].

In Table 5-3, Kendrick estimated the average incremental gross and net rates of return on capital returned, by major type, for the business economy, the United States and the private domestic economy, by stage of business cycle. This table shows that, except for the initial period of 1937 - 1948, the incremental rates of total capital reflected above average rates of return for human capital and low average rates of return for non-human capital.

As far as Kendrick is concerned, the 2.4% average annual growth of real product in the private domestic business economy from 1929 to 1969; and the 1% annual per growth rate for "Total capital productivity" reflecting the net impact of the residual forces, accounted for 30% of the economic growth rate. In the national economy as a whole, the proportion of economic growth attributable to expansion of total capital was larger than in business, but the calculations for

the business sector were more meaningful.

Assuming the same marginal productivity of tangible and intangible capital in the business sector, the contribution of tangible capital was 1.7 percentage points compared with 0.7 percentage points for intangible capital. Although the growth of real and tangible capital was significantly faster, its relative magnitude was much smaller, about 1/3 in 1929.

Therefore, of the 1.7% annual increase in tangible capital productivity (exactly half of the overall economic growth rate in the business economy), the relative growth of real and tangible capital counted for more than 40% in the total period, and was a bit larger than more than 40% in the 1949 to 1969 subperiod. The gross rate of return for total capital was 10.2% in 1929 and 10.8% in 1969; but the gross rate of return on human capital was above that from non-human capital throughout the period. The human capital rate of gross return stood at 11.7% in both 1929 and 1969, "compared with 9.2% and 9.9% for non-human capital at the beginning and end of the forty year span. The net rates of the return were very similar to the gross rates". [25,131-2].

It has generally been conceded that in the industrialized market economy the education of the labor force contributes significantly to a nation's progress. Kaser, in his article in the Economics of Education [24], studied a dozen industrialized market economies from the time they began through their growth periods, (roughly during a period from approximately 1860 to 1960 or a full century) and, although he did not attempt to study the type of education, he did find that a classical bias within the general education system was more conducive to economic progress. He also found a specific two decade time lag before educational input started to result in higher GNP, and the time lag growing longer as an economy

became more complex. He found a rise in per capita GNP linked with the ratio of secondary and university students to primary enrollments. In the same volume, Denison [11] found that to project an increase of 0.10 in national income growth rate over the next 20 years, in addition to all else that might be done (such as prevention of death, a cut of one-half in lost time because of illness and accident, an increase of 0.10 of all people in the labor force, doubling the rate of net immigration, etc.), an addition of one and one-half years to the average time that would otherwise be spent in school by everybody completing school between 1960 and 1980 or "an equivalent improvement of the quality of education" would increase the quality of labor input by 2.4% over and above what it should otherwise have been. In this study of economic growth, and in Denison's continuing work, he reported that the real national income or product of the United States from 1929 to 1957 increased at an average annual rate of 2.93%. He divided this growth rate proportionately among its contributing sources and concluded that education accounted for 0.67 percentage points or 23% of the annual average growth rate. He clearly separated the contributions of education to economic growth into two parts: one, improvement in the quality of the labor force due to more education, and, two, improvement in productivity due to advances in society's stock of knowledge relative to production. He emphasized that ary procedure to evaluate the relationship of additional education to growth required information on the amount of additional education actually received during the time period involved by the percentage of the population.

In quantifying the effect of increased education Denison used 1950 Census data. He reduced the income differential to 3/5 of the observed differential because he stated that the remaining 2/5 reflected the tendency for individuals of greater natural ability and energy to continue their education and that of other variables that are associated with, but not the result of, the amount of education. He said

that his 2/3 estimates of the contribution of additional education to growth was due to the combination of two facts: one, that labor represented 73% of the total input of all factors of production and, two, the large increase in the amount of education. The quality of labor Denison said improved almost 1% annually as a result of a 2% annual increase in the number of days of education.

The next major contribution to the theory of human capital development through education came from Schultz [37], who calculated that the annual growth rate between 1900 and 1957 of reproducible tangible wealth was about 2%; the annual growth rate of educational capital in the population was 3-1/2%; and the rate of growth of educational capital in the labor force was slightly over 4%. He estimated $40 billion growth in national income from investment in schooling alone, and the contribution of education of the labor force to economic growth between 1929 and 1957 at about 21% of the actual increase in national income. He estimated the rates of return on educational investment in the United States as follows: 35% for investment in elementary education; 10% for investment in high school education; and, 11% for investment in college level education. One weakness of Schultz's estimate was his assumption that all the costs of schooling were investment.

In the 1950's and 1960's, probably led by the work of Herman Miller, attention to earnings differentials as an indication of the efficiency of investment in human capital, was greatly emphasized. Miller had found that high school graduates had 26% and 48% more mean annual income than an elementary school graduate in 1946 and 1958, respectively. He also found that college graduates have 57% and 65% more mean annual income than high school graduates for 1939 and 1958, respectively. In 1958, Miller found that the average elementary school graduate, reportedly could

expect a lifetime income of about $192,000 as compared with about $258,000 for the average high school graduate. During this same period the college graduate could expect to receive about $435,000 lifetime income [29].

Becker [49], in his work for the National Bureau of Economic Research, paid particular attention to the differentials between the rate of return for college graduates and high school graduates, using 1950 Census data. Becker was primarily interested in the correlation between ability and education, and in the effects of possibly biased rate of return estimations based upon an income differential approach. He used five methods to investigate biases, and found that college itself was the chief contributor to the income differential between high school and college graduates. He concluded that, even after adjustments for differential ability and for possible bias, the private rate of return for a typical white collar, male college graduate would be considerable, say certainly more than 10% [49,79].

In the field of the economics of education the work of Blaug and Psacharopoulos stand out. Since Blaug's first volume An Introduction to the Economics of Education, the work of economists in the field has taken a more quantitative turn. His call for cost-benefit analysis (the felicific calculus), for more empirical data and quantification has been amply met over the past 7 years.

By 1973 Psacharopoulos' volume on Returns to Education [31] and Blaug's Education and the Employment Problem in Developing Countries [2] provided the basic context for investigations of the importance of education in various types of economies. In the Psacharopoulos' volume, the problem attacked was the economic return of investment in formal education in a large number of countries. The book attempted to analyze the role of education in the process of economic growth and development. All empirical evidence showed that education had both a private

and social monetary payoff and that this payoff was substantially higher in less-developed than in advanced countries. The most profitable educational level for society in most countries was the primary one, while higher education showed a modest payoff, particularly in advanced countries. Therefore, the arguments for universal education based upon human rights were also supported by good economic sense, [31,17].

A very important finding with respect to the less-developed countries was that returns to investment in human capital were well above returns to physical capital; while the returns on human and physical capital investment had almost equal magnitude in advanced countries. The suggestion, thus, was that less developed countries should give greater emphasis to investing in human as against physical capital; while in advanced countries considerations other than economic payoff have to be invoked to justify a further expansion of the educational system.

Psacharopoulos noted that per capita income differences could be better explained by differences in the endowments of human rather than physical capital, and investment in education contributed substantially to the rate of growth of output in most countries, particularly in the less-developed group.

Secondary educated qualified labor seemed to contribute more to total output than it was paid for; but higher education was very expensive in relation to the other levels particularly in the less-developed countries.

Earnings' inequality by educational levels decreased as the level of development rose, but the growth of physical capital in the developed countries appeared to work against any further movements towards earnings equality. He predicated a high degree of substitution in production between different types of educated labor in developed nations, and reported a very handsome return for those who graduated

in the home country and subsequently emigrated to the United States, thus explaining the brain drain.

Psacharopoulos' voluminous statistics can be summarized in a number of tables from his volume, particularly Tables 4.1, 4.5, 4.6 and 7.3, as shown below:

In the last portions of his volume, Psacharopoulos turned to the costs and benefits (benefits meaning earnings) of additional education by type of country. His tables 8.1, 8.2, 8.3 and 8.4 [31, 126-132] specifically showed that high income countries had narrower earnings differentials than lower income countries, at all educational levels. Ratii increased up the educational hierarchy in less-developed economies. Medium and low income countries appeared, on the average, to share similar earnings' ratii for the primary - no schooling interval; but for secondary-primary and higher-secondary, the earnings ratii were much greater in the low income nations. Higher-primary earnings' ratii rose markedly as we moved from high to low income areas. The ratii between graduates with higher education and people with no education varied widely between countries, but on the whole, they were again greater in the lower income countries. For all low and middle income countries, except Mexico and India, the eight years of secondary-higher education increased earnings relative to the primary level more than the eight years of primary education in relation to no education.

Blaug is well known as an expert in the economics of education and in one particular volume [2] he attacked the chronic problem of mass unemployment in less developed countries. He was well aware of the normal problems of unusually high rates of population growth (because of medical advances bringing about a reduction in the death rate long before there was a reduction in the birth rate), extremely low rates of capital accumulation and imperfect factor substitutability.

TABLE 4.1

SOCIAL AND PRIVATE RATES OF RETURN BY EDUCATIONAL LEVEL AND COUNTRY (percent)*

Country (1)	Year (2)	Social			Private		
		Primary (3)	Secondary (4)	Higher (5)	Primary (6)	Secondary (7)	Higher (8)
United States	1959	17.8	14.0	9.7	155.1	19.5	13.6
Canada	1961	..	11.7	14.0	..	16.3	19.7
Puerto Rico	1959	17.1	21.7	16.5	>100.0	23.4	27.9
Mexico	1963	25.0	17.0	23.0	32.0	23.0	29.0
Venezuela	1957	82.0	17.0	23.0	..	18.0	27.0
Colombia	1966	40.0	24.0	8.0	> 50.0	32.0	15.5
Chile	1959	24.0	16.9	12.2	..	..	..
Brazil	1962	10.7	17.2	14.5	11.3	21.4	38.1
Great Britain	1966	..	3.6	8.2	..	6.2	12.0
Norway	1966	..	7.2	7.5	..	7.4	7.7
Sweden	1967	..	10.5	9.2	..	..	10.3
Denmark	1964	..	..	7.8	..	..	10.0
The Netherlands	1965	..	5.2	5.5	..	8.5	10.4
Belgium	1967	..	..	9.3	..	..	17.0
Germany	1964	..	..	..	..	..	4.6
Greece	1964	..	3.0	8.0	..	5.0	14.0
Turkey	1968	..	..	8.5	..	24.0	26.0
Israel	1958	16.5	6.9	6.6	27.0	6.9	8.0
India	1960	20.2	16.8	12.7	24.7	19.2	14.3
Malaysia	1967	9.3	12.3	10.7	..	..	..
Singapore	1966	6.6	17.6	14.6	..	20.0	25.4
The Philippines	1966	7.0	21.0	11.0	7.5	28.0	12.5
Japan	1961	..	5.0	6.0	..	6.0	9.0
S. Korea	1967	12.0	9.0	5.0	..	..	..
Thailand	1970	30.5	13.0	11.0	56.0	14.5	14.0
Hawaii	1959	24.1	4.4	9.2	>100.0	5.1	11.0
Nigeria	1966	23.0	12.8	17.0	30.0	14.0	34.0
Ghana	1967	18.0	13.0	16.5	24.5	17.0	37.0
Kenya	1968	21.7	19.2	8.8	32.7	30.0	27.4
Uganda	1965	66.0	28.6	12.0	..	..	..
N. Rhodesia	1960	12.4	..	..	..	..	..
New Zealand	1966	..	19.4	13.2	..	20.0	14.7

* Source: [31, 62-3]

TABLE 4.5

RATES OF RETURN BY EDUCATIONAL LEVEL AND SEX IN CERTAIN COUNTRIES (percent)*

Country	Educational Level					
	Primary		Secondary		Higher	
	Males	Females	Males	Females	Males	Females
United States	17.8	5.6	14.0	13.0	9.7	4.2
Puerto Rico	17.1	17.2	21.7	20.9	16.5	6.3
Colombia	15.3	..	26.5	13.5	2.9	3.6
Germany	..	..	..	..	4.6	6.0
Greece	..	..	3.0	5.0	..	..
Kenya	21.7	7.1	23.6	19.5	..	..
Malaysia	9.4	9.3	12.3	11.4	10.7	9.8
New Zealand	..	..	19.4	25.3	13.4	13.5
Brazil	17.9	38.6	..	..	..	..
Singapore	9.4	3.8	18.2	17.0	15.4	13.7

*Source:[31,69]

TABLE 4.6

AVERAGE RATES OF RETURN BY EDUCATIONAL LEVEL AND SEX*

Educational Level	Males	Females	Difference
Primary	16.3	9.8	6.5
Secondary	17.2	15.5	1.7
Higher	9.6	7.2	2.4

* Source: [31, 69]

TABLE 7.3

THE CONTRIBUTION OF EDUCATION TO ECONOMIC GROWTH BY EDUCATIONAL LEVEL AND COUNTRY *

Country	Percentage contribution by educational level			Total contribution = 100 percent
	Primary	Secondary	Higher	
United States	43	31	26	17.9
Mexico	59	29	12	13.2
Venezuela	69	22	9	14.8
Colombia	54	39	7	24.5
Chile	56	34	10	11.4
Israel	46	36	18	4.7
India	35	53	12	34.4
Malaysia	43	49	8	14.7
The Philippines	18	50	32	10.8
South Korea	38	56	6	15.9
Nigeria	63	25	12	16.0
Ghana	37	49	14	23.2
Kenya	38	50	12	12.4
Average	46	40	14	16.4

* Source: [31, 119]

In discussing seven countries, he pointed out that, despite the great growth in the 1950's and 1960's, the employment problem was still a number one issue in the following countries: Colombia, Venezuela, Malaysia, Philippines, Sri Lanka, Ghana and Kenya. Looking at the economic growth pattern, he showed that heavy unemployment among secondary school graduates had recently become a familiar feature of many countries in Asia and Latin America. Blaug particularly noted the different unemployment patterns for secondary school non-graduates and those who had completed successively higher levels of education.

There seemed to be a mismatch problem between job expectations generated by the traditional educational system and job opportunities provided by the labor market. Somehow additional schooling in many countries aggravated the employment problem. Blaug also considered the fact that, the negative relationship in less developed countries between the unemployment rate and years of schooling, was obscured by population growth, and that expenditure patterns in these countries were making the upper levels of the educational system grow more rapidly than the lower levels. He noted that educated unemployment in many of the less developed countries was essentially the same as "youth unemployment", being mostly composed of workers under 25. He attributed this to rising enrollment rates, particularly in secondary and higher education, over the past ten or fifteen years.

"The most striking presumption to emerge from the burgeoning literature in the economics of education is that almost all less developed countries suffer from persistent underinvestment in primary education, hand-in-hand with persistent overinvestment in higher education". [2,15] This might have been due to improper (based on previous experience) manpower forecasting of the requirements for higher skilled jobs. He stated that almost all long-term manpower forecasts have turned out to be seriously wrong, and that only two to three year periods are fairly

accurate and useful for training programs, placement services and vocational guidance.

Blaug used rate-of-return analysis or benefit-cost analysis, where possible, both for individuals and for society. He estimated the extra earnings that typically accrued to people with additional education, after standardizing for differences in family background and (where possible) native ability, measured at an early age. However, no allowances were made for externalities, nor for other values. He indicated the private and social rates of return for specific educational levels in developed and less developed countries (Table 1). The social rate of return contained in this Table is the contribution to national income. The Table refers to 18 countries, of which 10 were less developed. He concluded that in less developed countries "primary education yields higher social rates of return than any other level of education....The discrepancies in rates of return to the different levels of education are, in most cases, so large that even huge shifts or resources over a period of five to ten years would not suffice to close the gap". [2,19]

TABLE 1. Private and social rates of return by educational levels in developed and less developed countries *

Countries	Secondary Education		Higher Education	
	Private Rate	Social Rate	Private Rate	Social Rate
Developed	11.9 (7)	9.5 (8)	11.9 (11)	9.4 (10)
Less Developed	18.5 (14)	15.2 (18)	22.0 (14)	12.4 (8)

Source: Psacharopoulos, op. cit., Ch. 4.
NB: The number of country observations are in parentheses. The dividing line between countries is GNP per head of US $1,000..

*Source [2,23]

In the matter of vocational versus primary education, Blaug argued that the differential cost of vocational education a priori lowered the benefit-cost ratio to the point where it could not succeed against primary education. The rapid growth of technology made specifically applicable vocational education in many places meaningless, and only general teaching of primary skills could fill vocational needs. Blaug also figured the ratio of social costs by educational level, per student per year [Table 2].

TABLE 2. Ratios of social costs by educational levels per student per year (primary = 1) *

Degree of Development	Secondary/Primary	Higher/Primary
Developed (New Zealand, United Kingdom, United States)	6.6	17.6
Intermediate (Chile, Colombia, Israel, Mexico)	6.6	20.9
Less Developed (Ghana, India, Kenya, Rep. of Korea, Nigeria, Uganda)	11.9	87.9

Source: Psacharopoulos. The economic returns to education....,op. cit., Ch. 8
NB: Social costs are defined as direct costs plus earnings foregone.

* Source: [2,24]

Blaug proposed greater investment in primary education, work study programs, or "recurrent education", and a re-emphasis on quality in primary education. He felt that, because all the emphasis so far has been on the benefits of education, very little work has been done on methods of cost reduction for higher or, for that matter, for primary education. He thought that broadly based primary education, by creating an adapting labor force whether in home, agricultural or industrial work, will, in and of itself, move individual countries' achievements higher [2, 80-88]. Underlying most of the analysis, there is a feeling that he is attacking the development problem in much the same way as American colonists did during the early years of exploration of this continent. He seems to be looking for a general knowledge dissemination base, in much the same way as our agricultural experiment stations were used after the formation of our original Department of Agriculture, and he desires a general underlying level of literacy within a country as a basis for future expansion of income and welfare.

In Blaug's work on human capital theory, his article on "Human Capital Theory: A Slightly Jaundiced Survey" [3] is particularly important. His major criticism was that a schooling model explanation of the distribution of earnings goes on "blindly assuming that all rates of return to human capital formation are equalized at the margin. Worse still is the persistent resort to ad hoc auxiliary assumptions to account for every perverse result, culminating in a certain tendency to monotonously grind out the same calculation with a new set of data, which are typical signs of degeneration in the scientific research program". [3, 849] Blaug saw the screening hypothesis as a turning point in the human investment economic theory, and he pointed out that the most fruitful empirical work in the testing of credentialist hypothesis continued to emerge from the friends rather than the enemies of human capital theory.

In his summary of human capital theory, the main weakness of the theory was found in an overemphasis on formal schooling, and neglect of a formal integration of "pre-school" and informal family investment into a more complete theory.

Blaug reviewed the literature on the proportion of earnings differential due to education relative to ability and other factors, in the United States. He did an intensive investigation of empirical surveys ranging from 1963-1973 for the alpha factor. The best summary of his findings can be found in his Table 3.9 [2, 56-57].

TABLE 3.9. Proportion of earnings differentials due to education relative to ability and other factors (U.S.A.)

Level of Schooling	Adjustment Reference	α	Source
Higher Education	Ability and other	.67	Denison (1964)
Primary	Ability and other	.88	Denison (1974)[a]
Secondary	" "	.88	
B.A.	" "	.88	
One Year Graduate Study	" "	.48	
Higher	Abilty	.80[b]	Becker (1964)
Higher	Ability and other	.65[c]	
Higher	Ability and other	.74[d]	
Higher	Ability and other	.81[e]	
Secondary	" "	.52[d]	
Secondary	" "	.73[e]	
Secondary	Ability and other	.40	Morgan and David (1963)[f]
B.A.	" "	.88	
Graduate Study	" "	1.00	
Two Year Post Sec. Technical	Ability and other	.73	Carroll and Ihnen (1967)
Graduate Study	Ability	.90	Ashenfelter and Mooney (1968)
Higher	Ability and other	.75	Weisbrod and Karpoff (1968)

Continued

TABLE 3.9 (Continued)

Level of Schooling	Adjustment Reference	α	Source
Years of Schooling	Ability	.49	Hansen, Weisbrod and Scanlon (1970)
Secondary Higher	Ability and other " "	.86 .73	Rogers (1969)
Years of Schooling	Ability	.96	Griliches (1970)
Years of Schooling after Mil. Serv.	Ability and other	.88	Griliches and Mason (1972)
Higher Education	Ability	.94	Hause (1971)
Primary Higher B.A. Graduate Study	Ability " " "	1.00 .979 .87[h] .89[g]	Hause (1972)
Years of Schooling	Mostly Ability only	.85[i]	Gintis (1971)
Higher	Ability and other	.65	Taubman and Wales (1973)
Years of Schooling	Ability	.81	Hauser et.al. (1971)

Source: See text, 2: 56-57

Notes:
a. Based on Table 3.1 above.
b. Using the Bell data or the Wolfle and Smith data and class rank as a proxy for ability.
c. Using the Wolfle and Smith data.
d. Using the Morgan and David results; averages for ages 18-34 and 35-74.
e. Based on Gorseline; not corrected for under-reporting of earnings.
f. Refers to the ages 35-44.
g. Using the NBER-TH sample.
h. Using the Rogers sample.
i. Overall average of the alphas implied in Gintis.

The first column is the level of schooling; the second contains the factors influencing the findings with respect to education, such as ability and other socio-economic factors; the third column lists the alpha; and the fourth lists the source. Alpha equals one, minus the reduction in the value of the schooling coefficient caused by the other factors such as ability and socio-economic background. The value of the schooling coefficient is taken as 100%, and all other factors are then subtracted to obtain alpha. Both of the other factors such as ability and socio-economic background are positively correlated with education and earnings; but the relative importance of alpha may differ with the level of schooling. For example, ability might not count so very much upon primary school graduation, if a child is poor and secondary education requires tuition.

It is extremely interesting to note, in Blaug's Table 3.9, that the lowest alpha was found by the Hansen, Weisbrod and Scanlon study in 1970 [20], which would assume that over 51% of the correlation between education and earnings was due to ability. However, none of the other surveys, except Becker in 1964 for ability and other factors, and Denison for one year graduate study, found an alpha as low. Most of the alphas seem to range in the higher level, which infers that education, not ability and socio-economic factors, is the primary reason for the earnings differential. In his Table 3.10, Blaug summarized the earnings differential due to education, by level of education, as follows:

TABLE 3.10 Proportion of earnings differentials due to education; by level of education

Educational Level	Alpha Coefficient	
	Ability only	Ability and other
Primary	1.00	.94
Secondary	n.a.	.68
Higher	.97[a]	.79
Graduate Study	.89	.82

Source: [2: 58]
Notes: The "ability only" column is from Hause (1972).

In Blaug's work, he not only investigated differential earnings by education level, but differential fringe benefits. Fringe benefits are a significant component of employee compensation. In Tables 6.1, 6.2, 6.3, and 6.4, Blaug presented evidence of the importance of fringe benefits all over the world.

TABLE 6.1. Fringes as a percentage of money wages by country

Country	Percentage of Wages
U.S.A.	23
U.K.	15
Austria	50
Belgium	31
Canada	22
France	52
Denmark	17
Germany	45
Greece	43
Israel	39
Italy	72
Netherlands	30
Sweden	15
Turkey	43

Source: [2: 138]

TABLE 6.2. Supplementary labor costs as percentage of earnings by country

Country	Percentage of Supplementary Labor Costs
Belgium	48.8
France	80.0
West Germany	61.8
Italy	99.3
Netherlands	50.7
U.K.	30.0

Source: [2:138]
Note: Data refer to the chemical industry in 1961.

TABLE 6.3. Percentage Importance of Selected Fringe Benefits in the U.S.A. 1929-1969

Year	Fringe Benefits[a] as a Percentage of Total Compensation
1929	1.4
1930-34	1.7
1935-39	3.4
1940-44	3.8
1945-49	4.6
1950-54	5.3
1955-59	6.7
1960-64	8.4
1965-69	9.5

Source: [2:139]
Note: a. Includes social security, unemployment, life and health insurance, as well as pensions. Paid leave and bonuses are excluded.

TABLE 6.4. Fringe Benefit Components as a Percentage of Total Payroll, U.S.A.

Item	1947	1961
Legally requirement payments	2.9	4.5
Pension plans	4.1	8.7
Paid rest periods (lunch, travel, etc.)	1.6	2.5
Paid holidays and sick leave	4.8	8.8
Profit sharing and bonuses	1.2	1.9
Percentage of Total Payroll	14.6	26.4

Source: [2:139]

Carroll and Ihnen in the Journal of Political Economy, December 1967, had issued an article on "Costs and Returns on Two Years of Post-Secondary Technical Schooling: A Pilot Study" [8]. Since fringe benefits are very closely allied to wages (the higher the wage the higher the normal fringe benefit), it is curious that this was the only explicit source where some evidence was given of fringe benefits by educational level. The comparison of fringe benefits of two-year post secondary technical school graduates relative to high school graduates is herewith stated:

TABLE 6.17 Fringe Benefits of Two-Year Post Secondary Technical School Graduates Relative to High School Graduates

Fringe Item	Technical Graduates	High School Graduates
Required hours of work/week	40.5	43.2
Days of paid vacation/year	9.8	8.9
Days of paid holidays	6.7	5.5
Maximum paid sick leave/year	30	24
Employer's share of life insurance premium (%)	81	71
Employer-sponsored retirement programs	37	27

Source: Carroll and Ihnen (1967), p. 873. [2:151]

The civil service is a place where fringe benefits can be estimated by educational level. The study of less versus more educated employees goes on in all countries. In addition to the normal supplemental benefits such as annual leave, social insurance, pensions and retirement, etc., most educated employees are required to work shorter hours than non-educated employees.

Blaug in his Tables 6.18 and 6.19 presented fringe benefits and hours of work for various levels of education for the United Kingdom. (In Table 6.20 he showed allowances of the percentage of basic pay by educational levels for Iran. In Table 6.21 he summarized the unemployment rate by education for the United States, and in Table 6.22 he issued the same rates for many other countries).

TABLE 6.18. Fringe Benefits by Educational Level, U.K. Civil Servants

Occupation	Annual Pay(lbs.)	Typical Qualifications	Annual Leave (days)	Leave Benefit as Percentage of Annual Pay
Messenger	996	None	21	5.8
Clerical Officer	1,489	O-level	24	6.6
Executive Officer	2,159	A-level	28	7.7
Senior Executive Officer	3,638	A-level or degree	30	8.2
Assistant Secretary	7,276	Degree	35	9.6

Source: Based on information supplied by the U.K. Civil Service Department. [2:152]

TABLE 6.19. Minimum Hours of Attendance per Week, U.K. Civil Servants

Occupation	Hours
Most occupations	41
Messengers and Telephonists	42
Cleaners	43

Source: U.K. Civil Service Department. [2:153]

Around the world, even with United Nations' statistics, data on fringe benefits by educational level are even more scanty. But, in most occupations, fringe benefits increase by the level of basic salary increases. Since more educated people earn higher salaries, it is obvious that they also obtain higher fringe benefits. Any absolute earnings data completely understates the level of true compensation differential by education level. Carroll and Ihnen had found that the differential fringe benefits for technical graduates increased to 20.1% of salary, as opposed to 16.5% for high school graduates. When only one item of fringe benefits was taken into account, it was sufficient to raise the traditional rate of return for investment in education by 1/5.

Blaug also presented an index of average annual earnings of labor by level of education in OECD countries in Table 7.1, and a comparison of relative earnings in OECD countries and in lower income countries by education level. (Table 7.2)

TABLE 7.1. Index of Average Annual Earnings of Labor by Level of Education in O.E.C.D. Countries

Country	Year	Educational Level		
		Primary	Secondary	Higher
Belgium	1960	100	251	502
Canada	1961	100	144	263
France	1968	100	183	289
Greece	1960	100	139	220
Italy	1969	100	141	244
Japan	1968	100	117	161
Netherlands	1965	100	131	152
Norway	1966	100	140	213
U.S.A.	1967	100	129	200
U.K.	1967	100	140	225

Source: [2:165]

TABLE 7.2. Relative Earnings in O.E.C.D. Countries and in Lower Income Countries

Country Group	Educational Level		
	Primary	Secondary	Higher
O.E.C.D.	100	140	219
Other	100	239	639

Source: "O.E.C.D. Countries" from Table 7.1, excluding the observation for Belgium. "Other Countries" are Malaysia, The Philippines, Ghana, South Korea, Kenya, Uganda, Nigeria and India, from Psacharopoulos (1973a), p. 132. [2:167]

The influence of education on the fringe benefit component of total earnings was considered later, in 1976, in a study by Duncan: "Earnings Functions and Non-Pecuniary Benefits". [12]

Duncan pointed out that, using data from two recent national surveys, education's well-documented, pervasive importance for pecuniary earnings carries over to fringe and non-pecuniary benefits as well. Education is a significant determinant of fringe benefits in all but one of the six non-pecuniary variables contained in the data sets. When pecuniary and non-pecuniary variables were combined into a single composite earnings measure, the estimated coefficient for education is considerably greater (25% in one data set, 10% in the other) than when earnings were measured by the wage rate alone.

This added importance of education existed even when cognitive ability, achievement motivation, and socio-economic backgrounds were taken into account. He found none of the other independent variables to have any consistent relationship with fringe non-pecuniary variables, except labor force experience.

In 1972, the Journal of Political Economy published an entire volume edited by Dr. Schultz on "Investment in Education: The Equity-Efficiency Quandary". [35] In this volume, there are two significant articles about the interaction of ability and schooling.

An article by Griliches of Harvard and Mason of Duke University [18] was based on the 1964 sample of veterans of the U.S. military. But, ability is measured by the performance at an age when most schooling had already been completed. The findings supported the statistical significance of schooling in the explanation of observed differences in income, together with a relatively low independent contribution of measured ability (based upon the army scores). Holding age, father's status, region of origin, length of military service and army ability scores constant, an additional year of schooling added about 4.6% to incomes of the sample. At the same time, a 10% improvement in the ability score would have added only about 1% to income. More important, using the variable of incremental schooling, the writers concluded that the bias in the estimated coefficient due to the omitted ability dimension was not very large (on the order of 10%). If the Armed Forces Qualification Test were a good measure of IQ and if IQ were largely inherited, then the authors concluded that the "direct contribution of heredity to income was minute, and its indirect effect was not very large". [18:S99]

The Griliches-Mason article was in direct contradiction to the findings of Hansen, Weisbrod and Scanlon, who, in 1976, analyzed a sample of 17 to 25 year old men rejected by the Selective Service due to low Armed Forced Qualification Test (AFQT) scores. They concluded that schooling was a relatively unimportant income determinant. [20] They had concluded that the educational coefficient dropped about 50% when the Armed Forces Qualification Test variable was introduced into the regression of income with age, color, size of family of origin (whether or not the

family of origin was intact) and education. The educational coefficient dropped even further when such current success variables as job training and marital status were added. The sample was peculiar, in that it concentrated on the very young.

But, it was well known, according to Griliches and Mason, that schooling income differentials are rather low at the beginning of labor force experience, and there was little evidence at that time for a strong schooling-income relationship among blacks. The rejection of the sample participants by Selective Service because of low AFQT's would have meant that most of the people in the Hansen, Weisbrod and Scanlon sample were not in the mainstream of American educational achievement, or high school graduates.

In the same JPE volume, an article by John C. House of the National Bureau of Economic Research on "Earnings Profile: Ability in Schooling", [21] used four samples of cohort data to explore the ability-schooling earnings relationships. This article is important in that some of the samples did cover measurements of intelligence prior to the finish of schooling, and in some cases, rather early in the educational process. .The four samples used were:

1) National Bureau of Economic Research-Thorndike sample of 2,300 white males who passed a battery of tests given to potential pilots and navigators in 1943. These tests were given upon completion of high school, with little or no additional schooling.

2) that obtained by Daniel C. Rogers of 343 white males, most of whom were Connecticut 8th graders when first tested for IQ in 1935.

3) the Project Talent sample of 8,840 white males who had full time employment in 1966, and who were high school juniors when they took

the Project Talent battery of ability and achievement tests. They had provided information on home backgrounds and interest in 1959, and answered a mail questionnaire in 1966.

4) Husé's sample of 450 Swedish males who were third graders in Malmo, when they were originally tested in 1938. Earnings data were obtained from income tax returns, and the sample had replied to a questionnaire in 1964.

From all the samples the statistical tests, based upon pooling the schooling-attainment classes and the patterns of coefficients of measured ability, by regression analysis within schooling class, strongly supported a hypothesis, that measured ability had significant complimentarity with schooling and job experience, for differential earnings analysis. The hypothesis focused on education as an investment, noting the important role foregone earnings played as the main cost of investment.

However, for low levels of schooling (less than high school graduates in the U.S. data) ability differentials were of negligible importance in causing earnings differentials. For high levels of schooling, one sample standard deviation of within schooling class measured ability was associated with earnings differentials, ranging from 10% to 13%, by the time males were 35 to 40 years old.

Another extremely interesting finding was, that the net opportunity cost for people of higher ability who acquired one or more college degrees, relative to the actual earnings profile of higher ability people leaving school after high school graduation, was not significantly raised by differences in ability. Therefore, there did not seem to be a serious overstatement bias of the rate of return to a college education compared to a high school education, due to an understatement of ability-related opportunity cost, even if ability data were not available.

The article by Taubman and Wales on "Higher Education, Mental Ability, and Screening" in the Journal of Political Economy, [44] is important because for the first time, an attempt was made to remove the screening certification or licensing effect of higher education from earnings differences due to productivity gains of higher education. According to the authors, most studies of the real returns to education were based on the premise that differences in earnings for different educational levels arose because of the various cognitive and effective skills acquired through education. The existence of income differences need not imply that education has produced such skills, since, instead, the differentials might arise, because lack of education has been a barrier to entry to high-paying occupations. [44,29]

The authors stated that, if people were denied an entry into an occupation because of the lack of educational credentials, the private rate of return to education differed from, and might be higher than, social rates.

This study used the National Bureau of Economic Research-Thorndike sample mentioned in many other studies, and deflated the social rates of return by regression analysis. None of the deflated social rates of return exceeded 11% (very few exceeded even 8% and, since the before-tax rate of return on physical capital in the years surveyed, 1958 and 1959, was approximately 13% to 15%, it appeared that society invested too many resources in education if the supply of savings were fixed).

The article covered only higher education, but the results are worthy of mention. They found that the higher the educational level, the lower the rate of return (excluding lawyers and doctors), suggesting that investment was greater at higher levels of education. The rates of return for some college and baccalaureate levels were higher than they would be if there were free entry into

high-paying occupations.

In corroboration, in 1970, an article by Gwartney on "Discrimination and Income Differentials" [19] showed that "a large portion of the income differential between white and non-white urban males is the result of differences in quantity of education and scholastic achievement. Differences between whites and non-whites and these two education-related factors are estimated to have accounted for non-white unrban males receiving between 23% and 27% less income than white urban males in 1959". [19,397] Gwartney found that one-third to three-fifths of the non-white-white income differentials remained unaccounted for, and that the residual was largely from employment discrimination.

There has been much work on why there is a high relationship between the level of schooling and workers' earnings. An article by Gintis on "Education, Technology and the Characteristics of Worker Productivity" [16] held that it was not the actual improvement in cognition, which schooling controlled, which explained the relationship between schooling and earnings. It is not important that schools raise the levels of cognitive development, but that the contribution of schooling to workers' earnings or occupational status suggested the importance of non-cognitive personality characteristics, which had direct bearing on worker earning and productivity.

The authority, motivational and interpersonal relations codified in the social structure of schools was held to be closely similar to those of the factory and office. This forced individual personality development conducive to performance, and the student's future work skills were facilitated. The grading structure in the classroom was held to be far more than a recognition of a student's cognitive attainment, by affording independent reward to the development of traits necessary to adequate

job performance. [16,267]

The problem of education as a screening device was further investigated by Kenneth I. Woltin in his article "Education and Screening". [48] Woltin specifically distinguished between screened and unscreened groups by using the unscreened group from a non-professional self-employed workers' sample and the screened group from a non-professional salary workers' sample.

By comparing the screened and unscreened groups, he stated that self-employed workers, in non-professional occupations, obtained about the same level of schooling as non-professional salaried workers. This was taken as evidence against a popular interpretation that screening was the cause of the main earnings differential for education. The actual tests used in the model were clearly not free of subjective judgment. The choice of the self-employed as an unscreened group relative to salaried workers was not obvious, and might not have been the only reason for the dichotomy.

The relationship between education and income was later studied by Rivlin and Okner, under the aegis of the Brookings Institution, in the early 1970's. They corroborated the fact that, on the average, people with higher levels of income had higher levels of education. In 1973 mean annual income of males age 35 to 44 with eight years of schooling was $9,486. For those with four more years of high school it was $12,045. For those with four more years of college it was $19,771. [30,206] Most of the difference was attributable to workers with higher levels of education earning more, although property income was also higher for those with more education.

Contrary to normal theory, which would expect that substantial increases in the proportion of highly educated people would increase competition for jobs requiring higher educational levels and lower the wages for these jobs, this study showed that

the narrowing of earnings differential among persons with various levels of education did not occur in the 1950's and 1960's. Table 14 of the study specifically estimated no proportionate decrease of earnings differentials. There was a proportionate increase between 1950 and 1973 in the ratio of median income of persons with various levels of education to medians for those with eight grade levels, for males ages 35 to 44.

Okner and Rivlin advanced one possible reason for the lack of the narrowing of earnings level ratii, that the initial narrowing began in the decade of the 1970's, since so many of the college graduates of the 1950's and the 1960's delayed entry into the labor market by going to graduate school, because of the Vietnam War.

TABLE 14. Ratio of Median Income of Persons with Various Levels of Education to Median of those with Eighth Grade Level, Males Aged 35-44, Selected Years 1950-1973

Education Level	1950	1960	1970	1973
High School				
1-3	1.13	1.15	1.13	1.10
4	1.26	1.29	1.27	1.37
College				
1-3	1.41	1.49	1.49	1.55
4+	1.83			
4		1.91	1.92	2.04
5+		2.00	2.05	2.17

Sources: Derived from U.S. Bureau of the Census, U.S. Census of the Population, 1950, Vol. IV, Special Reports, Part 5, Chapter B, Education (1953), Table 13; U.S. Bureau of the Census, U.S. Census of the Population, 1960, Subject Reports, Educational Attainment, Final Report PC(2)5B (1963), Table 6; and U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 97, "Money Income in 1973 of Families and Persons in the United States" (1975), Table 58 [30:209]

The finding in 1973 by Welch of the National Bureau of Economic Research in "Black/White Differences in Returns to Schooling", [47] that the observed rapid rise in the relative earnings of blacks in the United States between 1959 and 1966 was primarily due to a convergence of school completion levels; is of the utmost importance to the present study. Although much of the gain was associated with tightening labor markets, in the cyclical component, there was also a zenith effect to be considered, because blacks who entered the work force in recent periods were paid better than earlier entrants.

This analysis was supported in 1976 by an article "Black/White Differences in Return to Schooling: Some New Evidence" [27]. The Link, Ratledge and Lewis article based upon new evidence confirmed Welch. Blacks were definitely catching up. More important, the improved quality of black education was responsible for the black relative income gain, and not the differential advantage of a cyclical tightness in the labor market. School completion levels, according to Welch, had specifically accounted for part of the relative earnings increase of younger blacks; but it was found that a more important part of the gain came from the combined effect of increased schooling and "an increased return to schooling". [47,904] For example, based upon the direct returns to schooling (holding constant weeks worked and the probability of zero earnings) for the cohort with 13 to 25 years' work experience, the rise in black average school completions resulted in increases in earnings of 9.2% and (using the increases in white schooling) relative earnings would have increased by only 0.2%. Yet, based upon direct returns realized for the cohort with 0 to 4 years of experience, the increase in black earnings resulting from increased average schooling would have been 18.2%; and earnings, relative to whites, would have increased by 5.0%.

The data that Welch digested also suggested the importance of schooling quality. Through recent time, the relative quality of black schooling has risen rapidly. In the segregated South, the difference in enrollment attendance and expenditure patterns were declining since the 1954 U.S. Supreme Court desegregation decision. "First, not only has relative black income increased, but the gain has been greatest for high school completion levels. Second, the phenomena of rising returns to schooling is not only true in comparing black relative to white incomes, it holds within the races as well: young blacks do better in comparison to young whites than do older blacks in comparison to older whites, and schooling cohtains more of an income boost for young blacks and young whites than for older generations of their own races". [47,905]

The role of location as an influence on the earnings differential of blacks was investigated by Weiss and Williamson in "Black Education, Earnings and Inter-Regional Migration: Some New Evidence" [46]. This paper argued that the inferiority of southern black schools, particularly the rural schools, alleged by the Coleman Report to account for the poverty of black migrants to the North, can be discounted. The overall effect of a northern or large southern urban ghetto environment appeared to be more harmful to black economic progress than rural southern origin. However, the authors were unable completely to eliminate a selective migration effect.

More importantly the study did show a significant shift in the earnings function for blacks during much of the past decade. In 1967 education generated returns to blacks that were as high as those enjoyed by whites in 1960. It also appeared that the elasticity of income with respect to experience for young blacks increased markedly over this period of full employment.

These findings were strengthened by later articles by Smith and Welch "Black/White Male Wage Ratio: 1960-1970" [38], and by Link, Ratledge and Lewis "Black/White Differences in Returns to Schooling: Some New Evidence" [27]. The Smith, Welch article specifically investigated relative black/white earnings and wage ratios by schooling class and work experience for both 1960 and 1970; the usefulness of schools as a mechanism for increasing black economic status; and the effectiveness of anti-discrimination legislation in eliminating racial wage differentials. They proved that greater gains in earnings ratii were associated with increased schooling levels and that black school completions continued to rise relative to white levels. The cohorts fared better than their older peers.

The Link, Ratledge and Lewis comments on Welch's earlier article in 1973, upheld her dictum that the great increases in returns to black versus white education, were due to changes in the quality of education, and in addition, that the interactive relationships exhibited between years and school expenditures for blacks might partially explain the pessimistic conclusions of education's lack of impact on earnings of blacks found by researchers using 1960 data. The article by Link and Ratledge in the Journal of Human Resources "Social Returns to Quality of Education: A Further Statement" [26], is important because it bears out the work of others. By district, there were large but diminishing returns to incremental education expenditures. They suggested that the role of education in the large relative gains in black earnings during the 1960's worked through quality instead of quantity aspects. The total influence of a 1% increase in expenditures caused a .53% increase in annual earnings of blacks, and corresponding figures for annual earnings of whites were around .16%. The small increase in the quantity of education produced negligible calculated returns, and in the words of the authors: "...illustrate the high probability of failure for public programs which increase

the years for schooling of blacks without simultaneous increments in school quality" [26,88]. The most important aspect of the Link-Ratledge survey was that it was conducted by school district, instead of using average state-wide expenditure variables.

Along the same line, an article by Edwards, "Economics of Schooling Decisions: Teenage Enrollment Rates" [14] concluded that variations in the expenditure per pupil variable had a substantial effect on teenage schooling decisions. Not only was this variable highly significant in explaining state variations in enrollment, but also in explaining increases in enrollment during the decade of the 1960's. "The results reported here indicate that not only may unequal expenditures lead to unequal opportunities to obtain quality schooling, but also to unequal years of schooling actually attained". [14,171]

The basic work on social returns to quantity and quality of schooling by Johnson and Stafford appeared in the Journal of Human Resources [23]. Johnson and Stafford (Table 3) showed the influence of education expenditures (the analogue of quality) and years of schooling upon the predicted hourly wage level which would be earned at age forty. The regression obtained posited that an extra dollar of educational expenditure per pupil would reduce the amount of schooling necessary to reach a certain stock of human capital by about nine-tenths of one-percent per year. They evaluated the rate of return to quantity and quality of education (Table 4), by taking the marginal estimated social rates of return to completing high school and college for three different per pupil expenditure levels. Both Tables 3 and 4 referred to white urban dwellers. Table 5, completing the results, gave an estimate of the marginal social rate of return for a differential $25 of expenditure per pupil, for three expenditure levels: for grade, high school and college educational attainment.

TABLE 3. Predicted Hourly Wage Levels at Age 40 by Years of Schooling and Educational Expenditure Level[a]

Expenditure	Years of Schooling				
	8	10	12	14	16
150	2.40	2.74	3.11	3.52	3.98
200	2.54	2.90	3.29	3.73	4.21
250	2.65	3.03	3.44	3.90	4.40
300	2.75	3.14	3.57	4.04	4.56
350	2.84	3.24	3.68	4.17	4.70
400	2.91	3.32	3.78	4.28	4.83

a - URB and URBORIG set equal to one.

Source: [23,148]

TABLE 4. Marginal Social Rates of Return to Quantity of Schooling, Given Quality of Schooling

EXP	Educational Attainment	
	8 to 12	12 to 16
150	11.5	8.5
300	10.9	8.8
425	10.5	9.0

Source: [23,149]

TABLE 5. Marginal Social Rates of Return to Quality of Schooling, Given Quantity of Schooling

ED	Educational Expenditure		
	125 to 150	275 to 300	400 to 425
8	21.0	17.3	16.3
12	16.6	13.6	13.4
16	14.1	11.9	11.6

The general results do suggest that if all states had maintained school systems of a quality comparable to that of the U.S. over the past few decades, "rates of return to quantity and quality would be roughly in balance" [23,150].

The most important inference by Johnson and Stafford for the purposes of the present study is that the marginal estimated rates of return to school quality "are found to be considerably higher than the corresponding rates of return to years of schooling, which suggests an underinvestment in quality. However the marginal rate diminishes, the higher the levels of quality (given years of schooling)..." [23,153].

Estimates of rates of return on education by Shultz in his Investment in Human Capital: The Role of Education and of Research [36], were presented in his Table 10.1. Here, Shultz, for white males, estimated the private rates of return from 1939 until 1961, contrasting high school graduates and college graduates with corporate manufacturing profits and the implicit rates of return for the U.S. private domestic economy. Shultz also noted "What is more important is the underinvestment in the quality of elementary schooling..." [36,173].

Table 10.1—Estimates of Private Rates of Return, United States

	High School[1] Graduates: White Males after Personal Taxes (percent)	*College[2] Graduates: White Males after Personal Taxes (percent)*	*Corporate[3] Manufacturing Firms: after Profit but before Personal Taxes (percent)*	*U.S. Private[4] Domestic Economy: Implicit Rate of Return after Profit Taxes but before Personal Taxes (percent)*
1939	16	14.5		
1949	20	13.+	7.0 (for period 1947-57)	12.6
1956	25	12.4		14.4 (1955-56)
1958	28	14.8		12.3 (1957-58)
1959	Slightly higher than in 1958			9.7
1961	Slightly higher than in 1958			11.2 (1960-61)
1963-65				13.3

Source: [36,173.]

1. Gary S. Becker, *Human Capital* (New York: National Bureau of Economic Research, 1964), Table 14, p. 128.
2. *Ibid.*
3. *Ibid.*; here Becker draws on a study by George J. Stigler, see p. 115 and footnote 2.
4. Dale W. Jorgenson and Zvi Griliches, "The Explanation of Productivity Change," *The Review of Economic Studies*, 34 (July, 1967), Table 6, p. 268.

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In a later paper in The Journal of Human Resources, Carnoy and Marenbach wrote on "The Return to Schooling in the United States, 1939-1969". [7] They estimated rates of return for the United States for Census years during the period 1939-1969 for four groups of individuals: white male, non-white male, white females and non-white females. (In 1969, the category of negroes was first placed in the Census rather than a category of non-whites, but in the previous Censuses the non-white category averaged more than 90% black.) Table 1 presented unadjusted marginal private rates of return to investment in high school and college, based on income of those in the labor force (unemployed included) by sex and race, 1939-1969, in percentage terms for the United States. Although the level for black males and black females is substantially below the level of white males and white females, and the level of females is substantially below that of males, it was evidenced that the rates of return, even after taxes, for 1969 were substantially above average rates of return, for corporate profits, or average interest, which could be obtained from other investments.

TABLE 1

UNADJUSTED MARGINAL PRIVATE RATES OF RETURN TO INVESTMENT IN HIGH SCHOOL AND COLLEGE, BASED ON INCOMES OF THOSE IN LABOR FORCE (UNEMPLOYED INCLUDED), BY SEX AND RACE, 1939–69, U.S. (PERCENT)

				1969	
	1939	1949	1959	Income	Earnings
White Males					
High school 12/8	49.1 (20.3)[a]	22.7	14.6	18.8	14.0
College 16/12	21.4 (16.3)[a]	13.2[b]	17.6	15.4	16.2
Black Males					
High school 12/8	27.1 (30.0)[a]	14.7	13.1	16.1	19.9
College 16/12	14.6 (5.9)[a]	7.7	13.9	14.3	13.6
White Females					
High school 12/8	25.2 (13.7)[a]	20.0	14.8	19.2	15.1
College 16/12	18.4 (14.8)[a]	11.0	12.2	17.0	14.9
Black Females					
High school 12/8	10.0 (11.6)[a]	15.2	12.9	11.6 (13.8)[c]	19.1
College 16/12	30.0 (21.2)[a]	17.0	19.1	19.6	19.4

Source: See text. Income and earnings taken from U.S. Censuses for 1940, 1950, 1960, and 1970. [7, 316-317.]

Note: We also corrected the male private rates for federal income taxes. We assumed incomes were taxed at the single taxpayer rate (one exemption, standard deduction) from age 22; the married taxpayer rate from age 23 to 26 (two deductions, standard exemption); three exemptions, standard deduction from age 27 to 30; four exemptions from age 30 to 49; and two exemptions from age 50 to 60. Although this set of assumptions probably overestimates the tax adjustment, we found significant reductions in the private rates only in the case of college over high school. Even here, the adjusted rates were reduced by from 0 to 0.8 percentage point for the groups. (Details are available from the authors.)

We did not adjust rates for women because of the difficulty of determining the tax rates paid on women's incomes. Nevertheless, the effect of taxes on women's rates should not be very large, partly because their incomes are lower than men's and partly because of the same reason that the effect is small for males: The taxes applied to income forgone lowers the cost of going to school and offsets much of the decrease in income differentials due to federal income taxes.

[a] Gurenbach rates for the sample with zero incomes omitted.

[b] If it is assumed that the 16+ category in the 1949 Census represents 16.5 years completed rather than 16 years, the rate of return to college education for white males is 12.8 percent. Adjusted for taxes, the rate is 12.4 percent.

[c] Rate adjusted for possible overestimate of income forgone.

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In order to obtain these rates of return the authors did impute the costs of income foregone in addition to all other costs.

In addition to private rates of return for the four groups, Carnoy and Marenbach computed unadjusted marginal social rates of return to investment for primary school, high school and college educations in their Table 2.

TABLE 2

UNADJUSTED MARGINAL SOCIAL RATES OF RETURN TO INVESTMENT IN PRIMARY SCHOOL, HIGH SCHOOL, AND COLLEGE, BASED ON INCOMES OF THOSE IN THE LABOR FORCE (UNEMPLOYED INCLUDED), BY SEX AND RACE, 1939–69, U.S. (PERCENT)

				1969	
	1939	1949	1959	Income	Earnings
			White Males		
Primary 8/0	11.6 (12.6)[a]	12.7	13.2	7.2	–
High school 12/8	18.2 (11.3)[a]	14.2	10.1	10.7	9.0
College 16/12	10.7 (9.0)[a]	10.6[b]	11.3	10.9	11.0
			Black Males		
Primary 8/0	10.5 (14.7)[a]	13.9	10.6	6.3	–
High school 12/8	10.4 (14.2)[a]	9.1	8.3	9.0	11.2
College 16/12	6.5 (2.7)[a]	4.6	7.2	8.0	7.7
			White Females		
Primary 8/0	4.7 (10.9)[a]	7.8	3.9	neg.	–
High school 12/8	12.7 (9.6)[a]	11.5	9.3	8.3	7.4
College 16/12	9.8 (8.6)[a]	7.0	6.6	9.4	7.9
			Black Females		
Primary 8/0	6.8 (8.1)[a]	9.8	4.8	4.2	–
High school 12/8	4.8 (6.3)[a]	8.7	8.2	6.9 (7.6)[c]	10.3
College 16/12	11.1 (10.0)[a]	9.2	8.8	10.5	10.6

Source: [7, 318-319]
Notes: a - Marenbach rates for the sample with zero incomes omitted.
b - If it is assumed that the 16+ category in the 1949 Census represents 16.5 years completed rather than 16 years, the rate of return to college education for white males is 9.9 percent.
c - Rate adjusted for possible overestimate of income foregone.

The social rate of return to primary schooling fell between 1939 and 1969 for all groups. However, the trend in secondary social rates changed, and the pay off fell for whites (particularly between 1949 and 1959) but remained rather constant for blacks, and possibly rose between 1959 and 1969. Private rates of return to secondary education fell for all groups between 1949 and 1959 and rose between 1959 and 1969. The rates for black males' college education rose significantly since the 1930's and 1940's, and the rates for females fell, and then rose, after 1959.

Carnoy and Marenbach attempted to obtain rates for cohort data from the Censuses of 1940 and 1950. For black males only, the important part of their inference was that, for cohort data, the longitudinal estimates did not change the ordering of the social rates among levels of schooling indicated by cross-sectional estimates.

It was the opinion of these investigators, that the movements of rates of return to schooling within the next decades, the seventies and eighties, will probably decline, as it did between 1939 and 1969 for the primary school social average rate of return. This decline would be caused by a continued rise in schooling relative to physical capital, and by the participation of women (whose average earnings show both housewives and childbearing years) in the labor force. They expect rates for social returns to investments in high school to continue to fall gradually, while private rates will continue to rise. (Income foregone for those attending high school will begin to fall relative to the benefits of attending

high school). The social rates of return to college education will remain constant or begin to fall, while private rates will rise, particularly for white males and white females. One of the reasons for this would be that the relative increase in the number of college graduates will make employers prefer those with graduate training, putting downward pressure on the college rates of return, but increasing the upward pressure for the returns to graduate education.

Barring the economic analysis of returns to education, much socio-economic work has been done on the private and social benefits of various programs to assist the disadvantaged in the United States. Most of this work appears in the Journal of Human Resources, and the major portion of significant work was done in the 1970's.

The work of Stanley, who edited Pre-school Programs for the Disadvantaged [40], includes five papers and three discussions presented at the first annual Hyman Blumberg conference on research in early childhood education held at the John Hopkins University in February 1971. The first article by Bereiter stated "The fact remains that no pre-school program shows any promise of making, by itself, any permanent difference in the scholastic success of poor children". [40,12] Weikart's evaluation of the Ypsilanti demonstration project had conclusions similar to Bereiter's. Weikart found that the children who participated in the pre-school programs scored higher on IQ and achievement tests than children in the controlled groups, and these differences were substained until third grade achievement tests. However, Weikart stated that teachers in the traditional approach did not expect pupils to do well and thus there was what could be called a "reverse Hawthorne effect". He concluded that the chief variable in "pre-school" programs was not the curriculum but the motivation and supervision of the program staff.

The other articles discussing other programs that were not as cognitively oriented as the Bereiter or Weikart programs and the other authors in their analyses tended to denigrate the importance of data on cognitive gains. One of them, McAfee, clained that "...the greatest gains for many children were made in aspects of human behavior which were not measured -- enjoyment and success in learning, pride, accomplishment, pleasure in the school situation, increased skill and inter-personal relationships..." [40, 84]

The problem with the conference was that the evaluations were not well documented, and it was impossible to compare the effectiveness of the various approaches.

Another major attempt at quantifying effects came in Garms' article "A Benefit-Cost Analysis of the Upward Bound Programs". [15] Even though the upward bound program is a high school program operated by the United States Office of Education, with a goal of finding able high school students who would be unlikely to go on to college due to poverty or low perception of personal success associated with race or socio-economic status. The program identifies these students in their sophomore year. This means that the benefit-cost analysis of their intensive remedial education is a pre-college estimation.

Germs found, in total, that the private and social benefits and costs of the upward-bound program for white males and females, and non-white males and females, were positive for all four sex-race classifications at discount rates of 5 and 10%. He obtained this data by using older siblings of the same sex as the control group. Social net benefits were positive at a discount rate of 5% but negative at 10%. In addition, rather higher rates of college attendance by siblings indicated that the upward-bound program might function more as a device to identify those rather apt to go to college anyway, rather than as a program to help those who would otherwise be

very unlikely to go to college.

Germs (Table 3) stated the value for lifetime income associated with the education. Given the costs of the upward-bound program, his Table 4 showed the benefits and costs at specific discount rates, and his Table 5 stated the benefits and cost from society's viewpoint.

TABLE 3

VALUE OF LIFETIME INCOME ASSOCIATED WITH EDUCATION

Category	Total Income	Present Value at 5 Percent	Present Value at 10 Percent
White males			
1–3 years high school	$427,633	$132,262	$60,488
4 years high school	478,280	147,951	66,940
1–3 years college	534,013	153,187	63,151
4 or more years college	699,771	184,831	68,902
White females			
1–3 years high school	94,693	28,872	13,377
4 years high school	125,428	35,072	14,780
1–3 years college	147,986	40,580	16,729
4 or more years college	276,640	70,769	27,043
Nonwhite males			
1–3 years high school	268,268	86,543	40,636
4 years high school	309,765	99,817	46,323
1–3 years college	355,265	106,002	44,850
4 or more years college	423,395	116,268	44,622
Nonwhite females			
1–3 years high school	111,041	35,027	16,539
4 years high school	139,863	40,277	17,213
1–3 years college	176,101	49,494	20,515
4 or more years college	361,002	94,639	36,357

Notes: The assumption is made that real incomes in 1967 dollars at any given age will increase at 1.62 percent per year as a result of expansion of the economy.

Amounts shown are present values at age 16 of incomes from age 16 to 65, before taxes. Basic data are from U.S. Bureau of the Census, *Current Population Reports*, Series P-60, No. 60, "Income in 1967 of Persons in the United States" (Washington: U.S. Government Printing Office, 1969). Incomes during periods individuals are students are from Robert G. Spiegelman, *A Benefit/Cost Model to Evaluate Educational Programs* (Menlo Park, Calif.: Stanford Research Institute, 1968).

Median incomes were used, to help correct for the upward bias caused by using income rather than earnings data. Data, given by the Bureau of the Census at 10-year age intervals, were positioned at the midpoint of the interval and values for other years were determined by linear interpolation. A mortality correction is included.

Figures shown are for incomes *associated* with education. They include the effect of noneducational causal factors correlated with education.

Source: [15, 213.]

TABLE 4

BENEFITS AND COSTS FROM THE INDIVIDUAL'S VIEWPOINT[a]

	White		Nonwhite	
	Male	Female	Male	Female
Discount rate 5 percent				
Benefits				
Lifetime income differentials (after taxes)[b]	$5,209	$3,549	$3,943	$5,843
Upward Bound stipend[c]	210	209	224	224
Scholarships and grants[d]	454	394	683	498
Total benefits	$5,873	$4,152	$4,850	$6,565
Cost differentials[e]				
Tuition[f]	370	319	537	378
Extra living costs[g]	260	225	379	267
Total costs	$ 630	$ 544	$ 916	$ 645
Net benefits	$5,243	$3,608	$3,934	$5,920
Discount rate 10 percent				
Benefits				
Lifetime income differentials (after taxes)[b]	$ 770	$1,152	$ 354	$1,902
Upward Bound stipend[c]	202	201	214	214
Scholarships and grants[d]	373	324	561	410
Total benefits	$1,345	$1,677	$1,129	$2,526
Cost differentials[e]				
Tuition[f]	308	264	446	314
Extra living costs[g]	215	185	312	220
Total costs	$ 523	$ 449	$ 758	$ 534
Net benefits	$ 822	$1,228	$ 371	$1,992

[a] All figures shown as present value at age 16, the approximate age at which a decision is made to include a student in Upward Bound.

[b] Differentials are calculated by multiplying the proportion of Upward Bound students in each educational category by the present value of lifetime income for that category, and summing over all four categories. The same is done for siblings, and the difference between those figures is the raw differential. The raw differential is reduced by 25 percent to allow for taxes paid, and the result is again reduced by 25 percent on the assumption that only 75 percent of income differentials are *caused* by education.

[c] Stipends averaged $45.36 per month during the summer and $5.60 per month during the school year. For the whole program, stipends ranged from $218 for white females to $233 for nonwhite females. Figures shown are present values of these amounts.

[d] Scholarships and grants ranged from $739 to $793 per year for Upward Bound students and were assumed to be identical for siblings. Differentials shown arise because of differential rates of college attendance between Upward Bound students and siblings.

[e] Because present values are computed at age 16, the income series automatically shows foregone income as a reduction in benefits, and it is not included separately as a cost. This is also true of the reduced receipts of unemployment and welfare payments by educated individuals.

[f] Based on average 1968–69 tuition of $602 for all U.S. institutions.

[g] Assumes an average of $425 per year in extra living cost while in college.

Source: [15, 216-217.]

TABLE 5

BENEFITS AND COSTS FROM SOCIETY'S VIEWPOINT[a]

	White		Nonwhite	
	Male	Female	Male	Female
Discount rate 5 percent				
Benefits				
Lifetime income differentials (before taxes)[b]	$7,020	$4,777	$5,491	$7,942
Cost Differentials[c]				
Upward Bound cost to the government[d]	$1,811	$1,798	$1,922	$1,919
Upward Bound cost to colleges[e]	260	257	275	275
Cost of education[f]	1,057	872	1,424	1,028
Extra living costs[g]	260	225	379	267
Total costs	$3,388	$3,152	$4,000	$3,489
Net benefits	$3,632	$1,625	$1,491	$4,453
Discount rate 10 percent				
Benefits				
Lifetime income differentials (before taxes)[b]	$1,066	$1,560	$ 598	$2,609
Cost Differentials[c]				
Upward Bound cost to the government[d]	$1,737	$1,724	$1,845	$1,842
Upward Bound cost to colleges[e]	249	247	264	264
Cost of education[f]	852	724	1,183	856
Extra living costs[g]	215	185	312	220
Total costs	$3,053	$2,880	$3,604	$3,182
Net benefits	—$1,987	—$1,320	—$3,006	—$ 573

[a] All figures are present values at age 16.

[b] Differentials are calculated as in Table 4, including the assumption that only 75 percent of differentials are caused by education, but excluding the reduction for taxes paid. The effect of decreased receipts of unemployment and welfare benefits by educated individuals has been removed because in the social context these are transfer payments.

[c] As in Table 4, foregone income is included in lifetime income differentials as a reduction in benefits.

[d] Excludes cost of stipends paid students, which are transfer payments. Cost calculated from data furnished by OEO.

[e] Calculated from data furnished by OEO.

[f] Based on total economic cost of education, estimated at $623 per pupil in high school and $1,470 per pupil in college.

[g] Extra living cost is estimated at $425 per year while in college.

Source [15, 219]

Criticism of Garms' article was made by Christoffel and Celio of the U.S. Office of Education in a later issue [9]. The major criticism was about his use of the 10% rate, because this is the only rate at which Garms found costs exceeding benefits. They held that this 10% discount rate was based on an unreasonable bond rate and an arbitrary increment for risk; and, therefore, the analysis did not adequately measure the benefits accruing to society from upward-bound.

Relatively little investigation of the economic benefit-cost of "pre-school" investment has yet been carried out. The reasons for the lack of basic, empirical analysis are not hard to find. Accurate, unbiased statistics, within reasonable limits of probable error, would take years to compile, because the populations involved would have to be studied at least until their members reached the limits of schooling and were in the labor market (from 14 to 20 years).

Unbiased statistics,with other causal variables eliminated, would require intensive familial case histories and physical standardization for health comparability (the genetic disease problem).

Certainly, the proportions of funds required would vastly overshadow even the U.S. Government's massive negative income tax investigation, which cost millions.

Yet, intuitively, researchers appear to have reached positive conclusions about "pre-school" training for educationally deprived children. Even Sahota, in his latest 1978 survey of theories of personal income distribution, stated: "The productivity of pre-school investment, which comes before schooling and post-school investment, is believed to be very high..." [34,19].

The pioneering work on pre-school investment, the work of Bloom and his advisees at Chicago [4] produced evidence to the effect that home environmental variables were more closely related to children's ability than social status or innate factors, and that about 50% of the cognitive development of children occurred by the age of three or four.

These findings are similar to those which have taken place in the Drexel Early Childhood Center. The expected progressive declines in achievement scores (from Board of Education data) resulting from "deprived" environments in early childhood are not borne out for children who are coming into the Drexel Early Childhood Center, although initially they showed severe retardation.

This is contrary to the findings in the Coleman report [10] that disparities in existing school inputs made relatively small difference in school outputs in the form of fostering cognitive abilities for students, but that ability, family background and school quality had high collinearity.

Drexel's reports on early intervention in education indicate that education in the form of SCILS seems to bear fruit. It is entirely possible that Drexel's intervention bears fruit because it takes place in the early years, between ages 2.7 and 4.

Certainly the appearance of the Jencks report on Inequality in 1972 [22] seemed to shatter all hope that remediation of any form would do any good to educational differences and income inequality. The general conclusion of the Jencks study was that neither family environment, nor mental ability, nor school quality, determined specific proportions of educational inequality, and that none of these factors, nor educational attainment, nor occupational status, significantly altered income inequality.

Although the findings have not gone unchallanged, the empirical work done by Summers and Wolfe merits particular attention [42]. This basic microeconomic examination of Philadelphia School District data found that many school inputs do matter; that disadvantaged students can be helped by particular types of input; and that the use of pupil-specific data, instead of averaging, and statistical methods appropriate to such data accounted for much better results in the study. Instead of using an achievement level as an output measure, Summers and Wolfe used the change in achievement or differential achievement over a period of years, and they used interaction terms to allow the effect of policy variables with general, social and economic status to be measured.

With respect to the general disaggregation, the interaction analysis used by Sommers and Wolfe revealed that the non-black student with an IQ of 110 or more, moved much more rapidly ahead, but the black student did not; that higher achieving students benefited by being with more experienced teachers, but lower achieving students were adversely affected, "benefiting from newer teachers"; and that low achievers did better in classes with less than 28 students than in classes with 28 to 33, while high achievers did worse. The lower income students benefited most by having teachers who came from higher rated colleges and black students experienced a bigger boost to learning from being in smaller schools. The low achiever was the real beneficiary of being in a grade with a higher percent of high achievers, while the high achiever was unaffected; and the expected negative effect of being at a school with more serious disruptive incidents shows up only for extremely high achievers. Most important of all the findings was "that most of the effect of family income and race can be tagged to specific school input". [42,649]

Mnemonic Guide to Periodicals

AER - American Economic Review

JASA - Journal of the American Statistical Association

JEL - Journal of Economic Literature

JHR - Journal of Human Resources

JPE - Journal of Political Economy

QJE - Quarterly Journal of Economics

REFERENCES

[1] Blaug, M.: An Introduction to the Economics of Education. (Baltimore: Penguin Books, 1972).

[2] Blaug, M.: Education and the Employment Problem in Developing Countries. (Geneva: Internation Labor Office, 1973).

[3] Blaug, M.: "The Empirical Status of Human Capital Theory, A Slightly Jaundiced Survey". JEL, September 1976.

[4] Bloom, B.S.: Stability and Change in Human Characteristics. (New York: Wiley, 1964).

[5] Bowles, S.: "Schooling and Inequality from Generation to Generation". JPE, May/June 1972, Part 2.

[6] Cardell, N.S. and Hopkins, N.H.: "Education, Income and Ability: A Comment". JPE, February 1977.

[7] Carnoy, M. and Marenbach, D.: "The Return to Schooling in the USA, 1939-1969". JHR, Summer 1975.

[8] Carroll, A. and Ihnen, L.: "Costs and Returns for Two Years of Post-Secondary Technical Schooling: A Pilot Study". JPE, December 1967.

[9] Christoffel, P. and Celio, M.B.: "A Benefit-Cost Analysis of the Upward Bound Program: A Comment". JHR, Winter 1973.

[10] Coleman, J.S.: Equality of Educational Opportunity. (Washington: H.E.W., 1966).

[11] Denison, E.F.: The Residual Factor and Economic Growth. (Paris: OECD, 1964). "Measuring the Contribution of Education (and the Residual) to Economic Growth". (Contained in above, and in Robinson and Vaizey: The Economics of Education).

[12] Duncan, G.J.: "Earnings, Functions and Non-Pecuniary Benefits". JHR, Fall 1976.

[13] Duncan, D.B.: "Occupational Components of Educational Differences in Income". JASA, December 1961.

[14] Edwards, L.N.: "Economics of Schooling Decisions: Teenage Enrollment Rates". JHR, Spring 1975.

[15] Garms, W.I.: "A Benefit-Cost Analysis of the Upward Bound Program". JHR, Spring 1971.

[16] Gintis, H.: "Education, Technology and the Characteristics of Worker Productivity". AER, May 1971.

[17] Griliches, Z.: "Estimating the Returns to Schooling: Some Econometric Problems". Econometrica, January 1977.

[18] Griliches, S. and Mason, W.N.: "Education, Income and Ability". JPE, May/June 1972.

[19] Gwartney, J.: "Discrimation and Income Differentials". AER, June 1970.

[20] Hansen, W.L., Weisbrod, B. and Scanlon, W.J.: "Schooling and Earnings of Low Achievers". AER, June 1970.

[21] House, J.C.: "Earnings Profile: Ability in Schooling". JPE, May/June 1972.

[22] Jencks, C.: Inequality: A Reassessment of the Effect of Family and Schooling in America. (New York: Basic Books, 1972).

[23] Johnson, G.E. and Stafford, P.: "Social Returns to Quantity and Quality of Schooling". JHR, Spring 1972.

[24] Kaser, N.C.: "Education and Economic Progress; Experience in Industrialized Market Economies", in Robinson and Vaizey: The Economics of Education. (New York: St. Martins Press, 1966).

[25] Kendrick, J.W.: Formation and Stocks of Total Capital. (New York: NBER, General Series 100, 1976).

[26] Link, C.R. and Ratledge, E.C.: "Social Returns to Quantity and Quality of Schooling". JHR, Summer 1976.

[27] Link, C.R., Ratledge, E.C. and Lewis, K.: "Black-White Differences in Returns to Schooling: Some New Evidence". AER, March 1976.

[28] Miller, H.P.: "Annual and Lifetime Income in Relation to Education: 1939-1959". AER, December 1960.

[29] Miller, H.P.: Income Distribution in the United States. (Washington, D.C.: G.P.O., 1966).

[30] Okner, B.A. and Rivlin, A.M.: "Income Distribution Policy in the United States", in OECD: Education, Inequality and Life Chances. (Paris: OECD, 1975).

[31] Psacharopoulos, G.: Returns to Education: An International Comparison. (San Francisco: Jossey-Bass, 1973).

[32] Ribich, I.: Education and Poverty. (Washington, D.C.: Brookings, 1968).

[33] Robinson, E.A.C. and Vaizey, J.E. (ed): The Economics of Education. (New York: St. Martins Press, 1966).

[34] Sahota, G.L.: "Theories of Personal Income Distribution: A Survey". JEL, March 1978.

[35] Schultz, T.W. (ed): "Investment in Education: The Equity - Efficiency Quandary". JPE, May/June 1972.

[36] Schultz, T.W.: Investment in Human Capital: The Role of Education and Research. (New York: Free Press, 1971).

[37] Schultz, T.W.: The Economic Value of Education. (New York: Columbia University Press, 1963).

[38] Smith, J.P. and Welch, F.: "Black-White Male Wage Ratio: 1960-1970". AER, June 1977.

[39] Spence, A.M.: "Job Market Signaling". QJE, August 1973.

[40] Stanley, J.C. (ed): Pre-School Programs for the Disadvantaged. (Baltimore: Johns Hopkins Press, 1972).

[41] Stiglitz, J.E.: "The Theory of Screening, Education and the Distribution of Income". AER, June 1975.

[42] Summers, A. and Wolfe, L.: "Intradistrict Distribution of School Input to the Disadvantaged: Evidence for the Courts". JHR, Summer 1976.

[43] Taubman, P.J.: "The Determinants of Earnings! Genetics, Family and Other Environments: A Study of White Male Twins". AER, December 1976.

[44] Taubman, P.J. and Wales, T.J.: "Higher Education, Mental Ability and Screening". JPE, January/February 1973.

[45] Vaizey, J., Norris, K., Sherman, J., Lynch, P. and Leik, M.F.: The Political Economy of Education. (New York: Wiley, 1972).

[46] Weiss, L. and Williamson, J.G.: "Black Education, Earnings and Inter-regional Migration". AER, June 1972.

[47] Welch, F.: "Black-White Differences in Returns to Schooling". AER, December 1973.

[48] Woltin, K.I.: "Education and Screening". AER, December 1977.

[49] Becker, G.S.: Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. (New York: NBER-Columbia University Press, 1964).

Chapter 2

Benefit Cost Analysis

INTPODUCTION

This section will attempt to produce estimates of the present value differential lifetime income for an individual which result from different levels of schooling. Secondly, these figures shall be used to establish a social cost-benefit ratio for the SCILS program by making the assumption that exposure to SCILS will prevent functional illiteracy and reduce to zero the probability of a student dropping out of high school. We present a highlight of the possible returns to education. One may choose from many variables in an effort to expose the returns to education, i.e., employment, health, standard of living. Yet in addition to having a correlation with education as has been pointed out in several studies, and in Chapter 1, the status of these variables for a given individual is also correlated to income [1,147; 3,54]. If one wished to highlight the returns to education, the differential income received from increased education would imply the relationship with the other variables.

A. METHOD FOR OBTAINING THE DIFFERENTIAL INCOMES (INDIVIDUAL BENEFITS)

The following formula has been used to estimate the present value of individual differential lifetime earnings at different levels of schooling: [2,6]

$$V = \sum_{N=18}^{64} \frac{(1 + X)^{N-A+\frac{1}{2}}}{(1 + R)^{N-A+1}} \cdot P_N \ (Y_N^1 - Y_N) \qquad (1)$$

WHERE:

V = Present Value of differential lifetime earnings.

Y_N = Mean Income at age N (Y' being the value for the higher level of schooling)

X = Growth rate of the economy

R = Discount rate

P_N = Proportion of the age 18 population surviving to age N.

The values of Y_N were supplied by the Department of Census report P-106 [5,204-212]. This report provided mean earnings employed by age levels, for all workers employed at any time during the year. Thus, it implicitly assumed some of the effects of unemployment but not those due to loss of work for the entire year.

Since the data was furnished in 5 year cohort groups, the same format was used for the data on life expentancies (7,5-6).

B. RESULTS FOR INDIVIDUAL BENEFITS

The complete results of the income analysis for various growth and discount rates are furnished in Table IIA-1. An abridged version is given in Table II-1. These differential incomes may be viewed as the discounted return to a child for investing additional time in education, or the individual benefit. An individual benefit cost-ratio cannot be calculated, when there is no cost to the child. (See Section 3-B). It is assumed in this section that the SCILS program is a significant force in influencing the decision to continue education, due to its profound effect on the literacy of the individual. This assumption will be vindicated in Chapter 3 of this study.

TABLE II-1

Present Value of Individual Lifetime Differential Earnings, between some High School and Graduating High School *

Growth Rate	Discount Rate	All Races Both Sexes $	White Male $	Black Male $
.02	.04	35613	42022	25069
	.06	27080	32192	21540
	.08	21292	25309	18336
.025	.04	38298	45019	25964
	.06	28900	34321	22351
	.08	22560	26829	19227
.03	.04	41253	48258	26857
	.06	30892	36630	23184
	.08	23940	28476	19945

*Source: Table IIA-1.

C. SOCIAL COST BENEFIT ANALYSIS OF SCILS SYSTEM

Method:

The initial social benefit-cost ratio for the SCILS program will use the following form:

$$\bar{R} = \frac{\bar{Y}\, Di}{\bar{K} + \bar{S} + \bar{I}} \qquad (2)$$

where:

Di = dropout rate and/or functional illerate rate for cohort group i.

$\bar{Y}$ = increase in GNP due to differential income of students in program

$\bar{K}$ = Capital costs of system per year

$\bar{S}$ = Service and maintenance costs of system per year

$\bar{I}$ = Staff salaries per year

$\bar{R}$ = benefit cost ratio for SCILS program

All cost figures are these found through operation of the SCILS system at the DECC.

Y shall be found by solving the following equation:

$$\bar{Y} = (\bar{V}_x)\ T^*M \qquad (3)$$

where:

n = number of students using the system in a given year

$\bar{V}$ = average differential lifetime income between high school graduates and students having some high school computed at discount rate r and growth rate x (Table II-1)

$\bar{T}$ = total tax rate (Federal, state and local)

$\bar{M}$ = Value of Keynesian multiplier for the U.S. economy (=2)

*The analasys assumes the prevention of functional illiteracy, which is the practical equivalent of dropping out of high school (see Introduction).

If using the tax rate method, one need not make any assumption about the future consumption or savings patterns of the individuals. In addition, the tax rate method is more clearly linked to the project if it were government sponsored, since it highlights the benefit to be accrued from a government investment, rather than making a somewhat tenuous connection to the overall benefits for the society.

The analysis of the system will employ the following assumptions:

Assumption I: Each student will receive 15 minutes of instruction per day.

Assumption II: 15 minutes will be allowed to prepare for the next student.

Assumption III: Each student will attend for 25-week sessions per year.

Assumption IV: The system will operate for 7.5 hours per day. This assumption implies that the system is used only during working hours.

From these assumptions, one can see that the system will handle approximately 30 students a year. Also, such a system will provide 1875 minutes of instruction, or slightly over 30 hours, which is approximately the mean of the experimental group analyzed in Chapter 3.

a. COSTS

From Table IIA-2, one can solve for the denominator in equation (2). This figure shall be used as the total cost for the system. It should be noted that these costs are fixed within a broadly relevant range. Therefore, an increase in the student population, perhaps by limiting the student's ability to select any equipment, and hence increasing the number of students that can be handled in each time period, would not result in a significant increase in the costs.

b. BENEFITS

The benefits of the SCILS system, or the values of the numerator of equation (2) are given in Table IIA-4. It should be noted that while the discount rates chosen are large, the growth rates chosen are extremely conservative. Again, the tendency is to bias the figures downwards. The tax rate used in the analysis was 22% which is the percent of GNP which is made up of taxes, local, state and Federal (4), Table IIA-3 contains the dropout data.

c. COST-BENEFIT RESULTS

The solution to equation (2) for selected growth and discount rates are given in the Table II-2. In a study of this nature, one must not make the mistake of relying only on the results of the formula used in calculating the ratio. The omissions from this formula are nearly as important and, though generally qualitative in nature, should be investigated in more detail.

TABLE II-2

Societal Cost - Benefit Ratio-RI*, between Students having some High School and Graduating High School.

Growth Rate	Discount Rate	All Races Male & Female	White Male	Black Male
.02	.04	3.909	4:613	2.752
	.06	2.973	3.534	2.364
	.08	2.337	2.778	2.035
.025	.04	4.204	4.942	2.850
	.06	3.172	3.767	2.453
	.08	2.476	2.945	2.111
.03	.04	4.529	5.297	2.948
	.06	3.391	4.021	2.545
	.08	2.628	3.126	2.189

* Source: Tables IIA-1, IIA-2, IIA-3 and IIA-4.

1. Omissions from Costs

There exist two glaring omissions from the list of costs used to obtain the estimates for the cost-benefit ratio. First, equation (2) makes no allowance for the opportunity cost to the individual for participating in the program. If the SCILS technique were to be used as an early childhood method, the opportunity cost to the child would be zero, which is assumed to be the opportunity cost of 15 minutes for a child under 6 years old. But, if the technique were to be used for adult education, opportunity cost becomes a more realistic consideration. The cost of lost work or leisure time, though, would be difficult to quantify, but is none the less, a cost of implementing the system.

Another cost which should be mentioned is the cost of the SCILS physical plant. If the SCILS system were to be established in a completely detached facility, this would also become a realistic cost to the system. But this omission may be overlooked in light of two facts.

First, the SCILS system is compact, and each student is handled individually. Therefore, it requires very little space, and the need for a separate facility would be small. Secondly, the number and cost of employees is purposely overstated, and the money may be diverted to other expenses without a loss in capacity or efficiency.

2. Omissions from Benefits

As pointed out in the Introduction and first chapter of this paper, the possible returns to education are manifold. But as noted before, these are not so easily estimated, as is the case with income. Thus, we are not satisfied just to hint at some of these returns, and the possible benefits which the government might receive. Below are two significant examples.

Unemployment is a harsh reality of the U.S. economy, particularly in the urban centers. The SCILS program offers inner-city youths a chance for functional literacy, one of the primary determinants of employment status. Yet even if we disregard the region, race or sex, a recent Department of Labor study shows that high school dropouts have the highest unemployment rate of any educational cohort [3,54].

TABLE II-3

Unemployment Rates*, March 1977

Both Sexes, All Races	% of Labor Force
Elem: Less than 8 years	10.0
8 years	10.3
High School, 1 to 3 years	13.8
4 years	7.5
College, 1 to 3 years	6.0
4 years or more	3.3
White	
Elem: Less than 8 years	9.9
8 years	9.6
High School, 1 to 3 years	12.7
4 years	6.8
College, 1 to 3 years	5.5
4 years or more	3.2
Black	
Elem: Less than 8 years	10.5
8 years	15.3
High School, 1 to 3 years	20.0
4 years	14.4
College, 1 to 3 years	12.5
4 years or more	5.1

Source: [3,54]

Therefore, any program aimed at preventing dropouts and placing students in the mainstream of life will have fantastic rewards to the economy. Not only will the government be required to pay less unemployment compensation and welfare benefits, but the society as a whole will benefit from the existence of a more productive workforce.

As Crossman has pointed out in recent articles, many studies have shown that years of school completed is probably the most important correlate to good health [1,147]. What does such a claim mean in terms of a return to a government investment in SCILS? The effect is two-fold. First, the government would be required to supply

less funds for hospitalization and other health care, through the Medicaid program. But more importantly, a healthier workforce is more productive, which is good for the economy and the government. The less days lost to illness, the more taxes collected by the government.

Both of these examples seem rather cold in viewing the workforce only as a production factor. The most important return to education is not increased taxes nor increased productivity, but rather the entire society's confidence in both itself and the system. Such a return can never be measured, but exists nonetheless, and it must be considered in any decision concerning investment in education.

TABLE IIA-1

Present Value of Individual Lifetime Differential Earnings Between Some High School and Graduating High School *

Growth Rate	Discount Rate	ALL TOTAL $	ALL MALE $	ALL FEMALE $	WHITE MALE $	WHITE FEMALE $
.01	.03	35686.05	40790.21	33383.25	42113.86	34418.80
	.04	30946.10	35936.81	28873.07	36702.21	29739.60
	.05	27076.66	31797.52	25288.54	32189.21	26047.56
	.06	23893.75	28278.00	22402.00	28420.17	23090.63
	.07	21255.93	25287.23	20046.20	25263.91	30688.86
	.08	19053.16	22742.20	18099.30	22610.49	18711.40
	.09	17199.87	20570.61	16471.21	20369.48	17062.43
	.10	15628.70	18710.52	15094.35	18466.47	15670.54
.015	.03	38402.11	43445.53	36035.71	45146.30	37186.30
	.04	33170.21	38233.92	30973.11	39254.90	31915.22
	.05	28910.59	33771.84	26975.76	34336.74	27783.02
	.06	25416.79	29970.08	23774.96	30229.25	24494.77
	.07	22530.04	26736.98	21177.76	26792.14	21840.61
	.08	20126.88	23986.09	19043.22	23906.41	19668.52
	.09	18111.32	21640.82	17267.71	21473.38	17867.73
	.10	16407.94	19634.55	15773.65	19411.59	16355.96
.02	.03	41392.61	46270.06	39014.05	48426.91	40306.72
	.04	35613.28	40692.15	33318.41	42022.58	34352.93
	.05	30919.78	35892.09	28848.10	36667.14	29715.34
	.06	27080.69	31790.55	25289.79	32192.25	26048.47
	.07	23917.92	28297.75	22419.26	28449.15	23107.28
	.08	21292.94	25325.00	20073.32	25309.69	20715.00
	.09	19098.18	22791.84	18132.45	22666.77	18743.27
	.10	17249.09	20627.10	16507.55	20431.26	17097.22
.025	.03	44687.22	49260.74	42366.27	51968.49	43834.03
	.04	38298.91	43314.88	35912.80	45019.37	37091.51
	.05	33123.01	38164.72	30931.07	39194.24	31872.63
	.06	28900.39	33746.98	26965.34	34321.79	27772.34
	.07	25431.42	29977.09	23784.73	30245.93	24504.11
	.08	22506.82	26765.95	21200.13	26829.76	21862.21
	.09	20167.97	24029.92	19073.45	23957.54	19697.64
	.10	18158.18	21693.61	17302.25	21532.15	17900.88

(continued)

TABLE IIA-1 (Continued)

Present Value of Individual Lifetime Differential Earnings Between Some High School and Graduating High School

Growth Rate	Discount Rate	ALL TOTAL $	ALL MALE $	ALL FEMALE $	WHITE MALE $	WHITE FEMALE $
.030	.03	48318.58	52409.16	46148.0	55781.66	47831.02
	.04	41253.23	46102.76	38886.51	48258.84	40175.98
	.05	35541.04	40594.82	33254.02	41931.90	34287.53
	.06	30892.37	35846.32	28823.20	36630.78	29690.11
	.07	27083.71	31782.47	25290.25	32194.08	26048.61
	.08	23940/97	28316.73	22435.06	28476.71	23123.11
	.09	21329.07	25301.61	20099.79	25354.30	20740.55
	.10	19141.95	22839.88	18164.68	22721.48	18774.24
.035	.03	52322.59	55699.88	50423.93	59873.75	52370.88
	.04	44504.95	49052.73	42196.15	51753.21	43658.68
	.05	38196.83	43185.63	35850.84	44893.77	36997.71
	.06	33074.93	38094.79	30888.26	39132.63	31829.29
	.07	38889.29	33721.19	26954.21	34305.77	27760 94
	.08	25445.00	29982.82	23793.66	30251.24	24512.64
	.09	22590.72	26793.83	21221.86	26866.26	21883.20
	.10	20207.78	24072.10	19102.68	24007.04	19725.78

(continued)

TABLE IIA-1 (Continued)

Present Value of Individual Lifetime Differential Earnings: between Some High School and Graduating High School

Growth Rate	Discount Rate	BLACK MALES	BLACK FEMALES	Growth Rate	Discount Rate	BLACK MALES	BLACK FEMALES
.01	.03	25155.71	26551.89	.025	.03	27863.30	32588.30
	.04	23307.70	23195.25		.04	25964.14	28336.06
	.05	21581.54	20364.41		.05	24107.90	24742.20
	.06	19993.72	17971.43		.06	22351.28	21704.93
	.07	18547.14	15942.53		.07	20721.47	19134.78
	.08	17236.77	14215.84		.08	19227.57	16954.35
	.09	16053.58	12740.37		.09	17868.57	15098.57
	.10	14986.56	11473.83		.10	16637.48	13512.79
.015	.03	26063.66	28417.38	.03	.03	28728.20	34909.59
	.04	24181.34	24781.95		.04	26857.42	30320.06
	.05	22402.45	21715.21		.05	24983.50	26434.09
	.06	20753.83	19123.88		.06	23184.03	23147.68
	.07	19244.64	16928.78		.07	21498.95	20366.91
	.08	17873.27	15062.95		.08	19945.14	18009.27
	.09	16632.66	13470.93		.09	18526.13	16004.75
	.10	15512.64	12186.52		.10	17237.46	14294.07
.02	.03	26970.14	30426.79	.035	.03	29545.98	37397.24
	.04	25069.13	26592.79		.04	27737.46	32452.69
	.05	23245.81	23171.88		.05	25865.88	28255.61
	.06	21540.31	20366.07		.06	24034.76	24701.85
	.07	19969.63	17990.85		.07	22300.20	21683.96
	.08	18536.88	15974.06		.08	20688.85	19144.75
	.09	17237.51	14255.54		.09	19210.18	16979.07
	.10	16062.72	12784.93		.10	17863.16	15133.03

(continued)

TABLE IIA-1 (Continued)

Growth Rate	Discount Rate	ELEM: - SOME HIGH SCHOOL	ELEM.-HIGH SCHOOL GRAD.	H.S. - SOME COLLEGE	H.S. - COLLEGE GRAD.	SOME COLLEGE COLLEGE GRAD.
		ALL	ALL	ALL	ALL	ALL
.01	.03	6127.18	41817.59	22656.01	63505.19	60849.47
	.04	5122.43	36071.34	17904.23	68736.25	50832.42
	.05	4301.10	31379.57	14144.20	57066.46	42922.20
	.06	3622.19	27517.09	11156.45	47785.68	36629.17
	.07	3055.39	24312.06	8772.68	40358.22	31585.48
	.08	2577.86	21631.52	6862.79	34374.55	27511.71
	.09	2172.30	19372.50	5326.32	29521.96	24195.57
	.10	1825.31	17454.22	4085.08	25559.14	21474.04
.015	.03	6707.48	45115.05	25410.77	92241.61	66771.38
	.04	5597.36	38771.09	20148.84	75675.88	55527.46
	.05	4694.27	33607.14	15940.91	62610.10	46669.14
	.06	3951.23	29369.46	12600.40	52240.85	39640.39
	.07	3333.48	25864.46	9938.04	43961.14	34023.04
	.08	2815.01	22942.49	7807.32	37307.04	29499.66
	.09	2376.16	20487.89	6095.13	31924.36	25829.18
	.10	2001.79	18410.00	4713.38	27540.16	22826.77
.02	.03	7347.91	48747.32	28607.98	102006.60	73398.94
	.04	6118.86	41736.52	22649.02	83419.38	60770.90
	.05	5123.92	36046.54	17940.43	68784.00	50844.04
	.06	4309.11	31391.62	14205.72	51192.68	42986.93
	.07	3634.69	27553.80	11232.15	47956.77	36723.56
	.08	3070.90	24304.62	8854.93	40551.41	31696.43
	.09	2595.39	21694.06	6946.78	34575.71	27628.87
	.10	2191.02	19440.46	5408.57	29720.88	24312.28

(continued)

TABLE IIA-1 (Continued)

Present Value of Individual Lifetime Differential Earnings: between Various Educational Levels

Growth Rate	Discount Rate	Elem-Some H.S.	Elem-Grad. H.S.	H.S.-Some Coll.	H.S. - Grad. Coll.	Some Coll.-Grad. Coll.
		ALL	ALL	ALL	ALL	ALL
.025	.03	8056.16	52751.82	32103.38	112922.00	80818.94
	.04	6692.68	44997.05	25433.43	92062.94	66629.63
	.05	5594.36	38720.90	20165.63	75664.19	55498.96
	.06	4699.16	33601.83	15990.49	62699.74	46709.19
	.07	3961.53	29394.44	12669.35	52390.91	39721.48
	.08	3347.45	25909.24	10017.03	44143.63	34126.52
	.09	2831.47	23000.08	7890.38	37504.27	29613.85
	.10	2394.16	20552.77	6177.91	32123.62	25945.66
.03	.03	8841.04	57190.15	35996.09	125123.70	89127.81
	.04	7325.39	48585.39	28533.53	101713.00	73179.56
	.05	6110.50	41655.95	22641.62	83333.50	60692.33
	.06	5125.07	36020.29	17974.75	68827.06	50852.59
	.07	4316.80	31402.36	14265.58	57314.74	43049.09
	.08	3646.84	27589.02	11306.28	48123.84	36817.48
	.09	3086.09	24415.96	8935.98	40741.60	31805.57
	.10	2612.51	21754.90	7029.39	34773.27	27743.82
.035	.03	9712.50	62048.19	40328.85	138762.80	98434.06
	.04	8024.47	52537.85	31983.95	112488.30	80504.56
	.05	6677.99	44880.27	25396.22	91884.94	66489.06
	.06	5591.06	38669.55	20180.70	75648.06	55467.84
	.07	4703.75	33595.35	16038.49	62785.43	46746.89
	.08	3971.50	29417.99	12736.69	52536.85	39800.08
	.09	3361.12	25952.84	10094.75	44322.96	34228.15
	.10	2847.53	23055.95	7971.94	37697.58	29725.59

* Sources: Solutions to Equation 1, page 65. Equation found in [2,127-129] Y_n found in [5, 204-212] and P_n found in [7, 5-6].

TABLE IIA-2

COST COMPONENTS (a)

I. System

- Hardware

  1 Talking Typewriter
  2 Talking Page
  2 Voice Mirror
  1 Talking Page & Voice Mirror backup
  3 Booths

- Associated Courseware and Material

  Cost $12,500.00

II. Service

- One year service contract 4,600.00

III. Staff

- 1 Professional 15,000.00
  2 Para - Professional 8,000.00 ea.

  31,000.00

TOTAL COST $48,100.00

(a) Figures reflect those obtained through operations at Drexel's Early Childhood Center.

TABLE IIA-3

Dropout Rates and Functional Illiteracy [a]

Dropout Rate: Philadelphia School System	13%
Functional Illiteracy: Philadelphia School System	38%
Figure used in calculation of Equation (2)	40% [b]

(a) Source: [8;9]

(b) 40% represents a conservative estimate of the total effect. Thus, the analysis assumes that 12 of the 30 students in the program would have either dropped out or been functionally illiterate at graduation, if they had not had SCILS training.

TABLE IIA-4

SOCIETAL BENEFIT *: $\bar{Y}$

Growth	Discount	ALL RACES MALE & FEMALE $	WHITE MALE $	BLACK MALE $
.02	.04	188036	221876	132464
	.06	142982	169973	113731
	.08	112421	133632	97870
.025	.04	202213	237700	137090
	.06	152592	181215	118013
	.08	119117	141657	101519
.03	.04	217816	254802	141804
	.06	163110	193406	122412
	.08	126403	150353	105310

* $\bar{Y} = (\bar{V}_x)\ TM$

$\bar{V}_x$ source is Table IIA-1 for the present value of earnings differentials between only having some high school and graduating high school.

T is the total tax rate of 22%

M is the Keynesian multiplier for a single year, which equals 2.

REFERENCES

[1] Grossman, Michael. "The Correlation between Health and Schooling" in Household Production and Consumption. Studies in Income and Wealth, Vol. 40. (Ed., Nestor E. Terlecky) (New York: NBER, 1975).

[2] Miller, Herman P. Income Distribution in the U.S. (A 1960 Census Monograph) (Washington, D.C.: U.S. Government Printing Office, 1966).

[3] Educational Attainment of Workers, March 1977. Special Labor Force Report 209. (Washington, D.C.: U.S. Department of Labor, Bureau of Labor Statistics, 1977).

[4] Statistical Abstract of the United States. (Washington, D.C.: U.S. Department of Commerce, Bureau of Census, 1977).

[5] Money Income in 1975 of Families and Persons in the U.S. , Series P-60, No. 105. (Washington, D.C.: U.S. Department of Commerce, Bureau of the Census, 1977).

[6] Annual Mean Income, Life Time Income, and Educational Attainment of Men in the United States, for Selected Years, 1965 to 1972. Series P-60, No. 92. (Washington, D.C.: U.S. Department of Commerce, Bureau of the Census, 1974).

[7] Vital Statistics of the United States, 1973, Vol. II, Part A. (Rockville, Maryland: National Center for Health Statistics, 1977).

[8] Rodgers, Kathleen. Analysis of Reading Scores, Philadelphia School District. (Paper) (Philadelphia: Drexel University, 1976).

[9] Philadelphia High School Reports. (Philadelphia, Pennsylvania: School District of Philadelphia, Office of Research and Education, 1976).

CHAPTER 3

THE LONGITUDINAL STUDY
1969-1978

RATIONALE

While the past few years have seen a decline in the application of federal funds for education in general, this is less so for the early childhood years. Research on intervention in the formative years (e.g., Durkin, Deutsch, Chall) seems to indicate the importance of this period to later growth and development. Poor children, in particular, have a predisposition in reading problems primarily in the years three to seven (Frostig and Horne).

While the literature underlines the need to capitalize on the early years, little is still known about how children learn. Another problem is how, then, to teach. To remediate deficits, to teach to strengths, to utilize dual modalities, etc., are common discussions in the parlance of education and psychology.

The literature is consistent and definite about the values of language arts and reading in early childhood programs. Shifts toward these academically oriented areas for "pre-elementary" children are but little more than a decade new, however, Campbell and Guthrie discuss the research findings on pre-kindergarten reading and language arts. They advocate continual grouping and regrouping of pupils as they master skills involved in early reading. Hillerich recommends screening for potential difficulties and modalities long before kindergarten. Venezky focuses his work on defining pre-reading skills to determine their value in early reading experiences. Wolpert underlines the importance of "vocal encoding and its spoken counterpart" in creating purpose for reading. Fischer has correlated pre-school language skills with later reading and speaking.

With support from others in the field and a commitment to early teaching and learning, the Drexel Early Childhood Center began its current efforts in 1967. The investigators sought to answer these questions.

1. What is known about early experiences in reading for "pre-elementary" children?
2. How can a voluntary, individually-oriented reading approach encourage positive performance gains for children regardless of socio-economic background?
3. What are the necessary components in developing an early reading program that can be generalized to other populations without specific teacher training?
4. What will be the long range effects on achievement of pupils with early training using SCILS.

The present study was undertaken in an attempt to develop a technologically based early reading and language program for children ages 3 to 6 who attended Drexel University's Early Childhood Center. From the inception it was the intent to follow the initial group of subjects in order to gauge the gains of treatment.

TREATMENT

Treatment consisted of daily sessions no more than twenty minutes in length; the primary components of this treatment were the talking typewriter, talking page and voice mirror. The determination of the instrument for a given day was based upon the discretion of the teacher.

Work was arranged to accentuate auditory or perceptual strengths of subjects and to remediate weaknesses secondarily: the ratio for that balance was 3:1. The objectives of the programming were the demonstration of skills

in (a) recognizing alphabet letters, (b) typing letters from dictation, and (c) reading words orally. Teachers also worked with children on individual experience stories which were then programmed for the equipment.

SUBJECTS

The study has two major divisions. The first division is a descriptive presentation of the reading achievement of SCILS children as they progress through elementary school. The data for these statistics comes from subjects who fall into 3 groups: 1) all children, middle and low income who participated in SCILS and who attended either the Drexel Center or another early childhood center: 2)(Group G) all low-income children who attended the Drexel Center; and 3)(Group G*) high risk, low-income children (initial I.Q. score below 90) who attended the Drexel Center. Table 1 presents the number of subjects in the first and second group. For each test given, each child is counted once for each grade he has been in and for which test data is available.

* of the cost-benefit analysis

TABLE 1

NUMBER OF SUBJECTS USED FOR DESCRIPTIVE STATISTICS

	ALL SCILS CHILDREN MIDDLE & LOW INCOME			ALL LOW INCOME DREXEL CHILDREN		
	WRR	IWR	Spache	WRR	IWR	Spache
1	N = 20	N = 19	N = 11	N = 9	N = 8	N = 4
2	N = 24	N = 24	N = 20	N = 13	N = 13	N = 10
3	N = 22	N = 22	N = 19	N = 13	N = 13	N = 11
4	N = 13	N = 13	N = 13	N = 10	N = 10	N = 10
5	N = 7	N = 7	N = 7	N = 6	N = 6	N = 6
6	-	-	-	N = 5	-	N = 5

Table 2 presents the breakdown by grade and test of the high risk low income children. It was decided to present a separate picture of their progress because they represent the children for whom the prognosis for school success was poorest. At the time of their attendance at the Drexel Farly Childhood Center (1969-1972), the initial mean I.Q. of this group was 71.8. Each child is counted once for each grade he has been in and for which test data are available.

TABLE 2

NUMBER OF HIGH RISK LOW INCOME SUBJECTS USED FOR DESCRIPTIVE STATISTICS

	WRR	Spache
1	N = 6	N = 4
2	N = 11	N = 8
3	N = 13	N = 11
4	N = 9	N = 9
5	N = 6	N = 6
6	N = 5	N = 5

The second division is an attempt to correlate time in the SCILS program with the reading ability of the participants. At present, there are not enough children in grades 5 and 6 to include these grades in the analysis. Thus, the subjects for this analysis include low income children (Get-Set and Title XX) and middle income children who participated in SCILS during their years at the Drexel Center At the time the data were collected, these children were in grades 1 through 4.

Additionally, a group of low income children who attended a neighboring kindergarten program (Kindergarten A) but participated in the SCILS program are included in parts of this analysis. They were excluded only when time in attendance at the Drexel Early Childhood Center was used as a variable. At the time the data was collected. these children were in grades 1 and 2.

As with the first division each child contributes a score for each grade he has been in; Table 3 presents the breakdown of the subjects in this analysis.

TABLE 3

NUMBER OF SUBJECTS USED FOR MULTIVARIABLE ANALYSES

	Drexel ECC			Kindergarten A	
Grade	Low Income	Middle Income	Total	Low Income	Total
1	n = 9	n = 7	16	n = 5	21
2	n = 13	n = 8	21	n = 3	24
3	n = 13	n = 9	22	-	22
4	n = 10	n = 3	13	-	13

MEASURES

The primary purpose of this study was to evaluate the impact of SCILS on the long-term reading achievement of participants. Subjects were assessed through a number of tests during the course of their academic career. The following measures of reading achievement were used as dependent variables:

1. Wide Range Reading (WRR) - test for letter and word recognition
2. Informal Word Recognition (IWR) - test for word attack skills
3. Spache Diagnostic Reading Scale (Spache) - comprehension reading test

In the statistical analysis, the WRR was found to be the most complete source of results. (i.e. the test for which the most data points were available). In addition, the other two scores were found to correlate very highly with the WRR. Therefore the results of the WRR tests were used as a measure of reading ability assuming comparable achievement in word attack and comprehension.

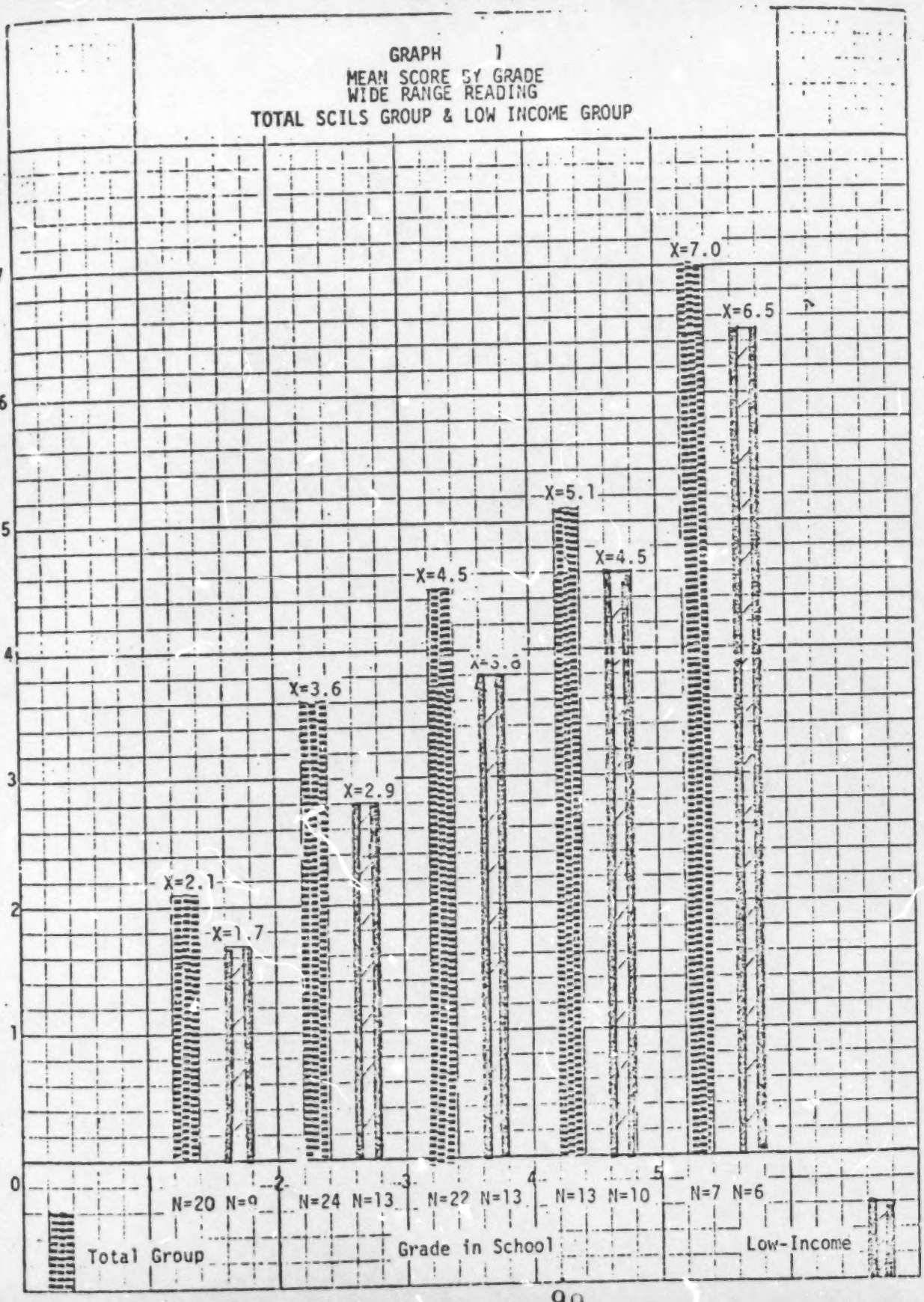
Time on SCILS was used to measure the treatment variable. Other measures which might affect reading achievement were examined statistically: Time enrolled at Drexel Early Childhood Center (ECC); socio-economic class (SES); initial I.Q. scores as measured by the full scale Wechsler Intelligence Scale for Children (WISC) or the Peabody Picture Vocabulary Test which, although hardly interchangeable have been found to intercorrelate significantly (see Annual Report, Steg, et. al. "Early Intervention Through Technology", van Leer Foundation, The Hague, Holland, 1976-77).

DESCRIPTIVE STATISTICS

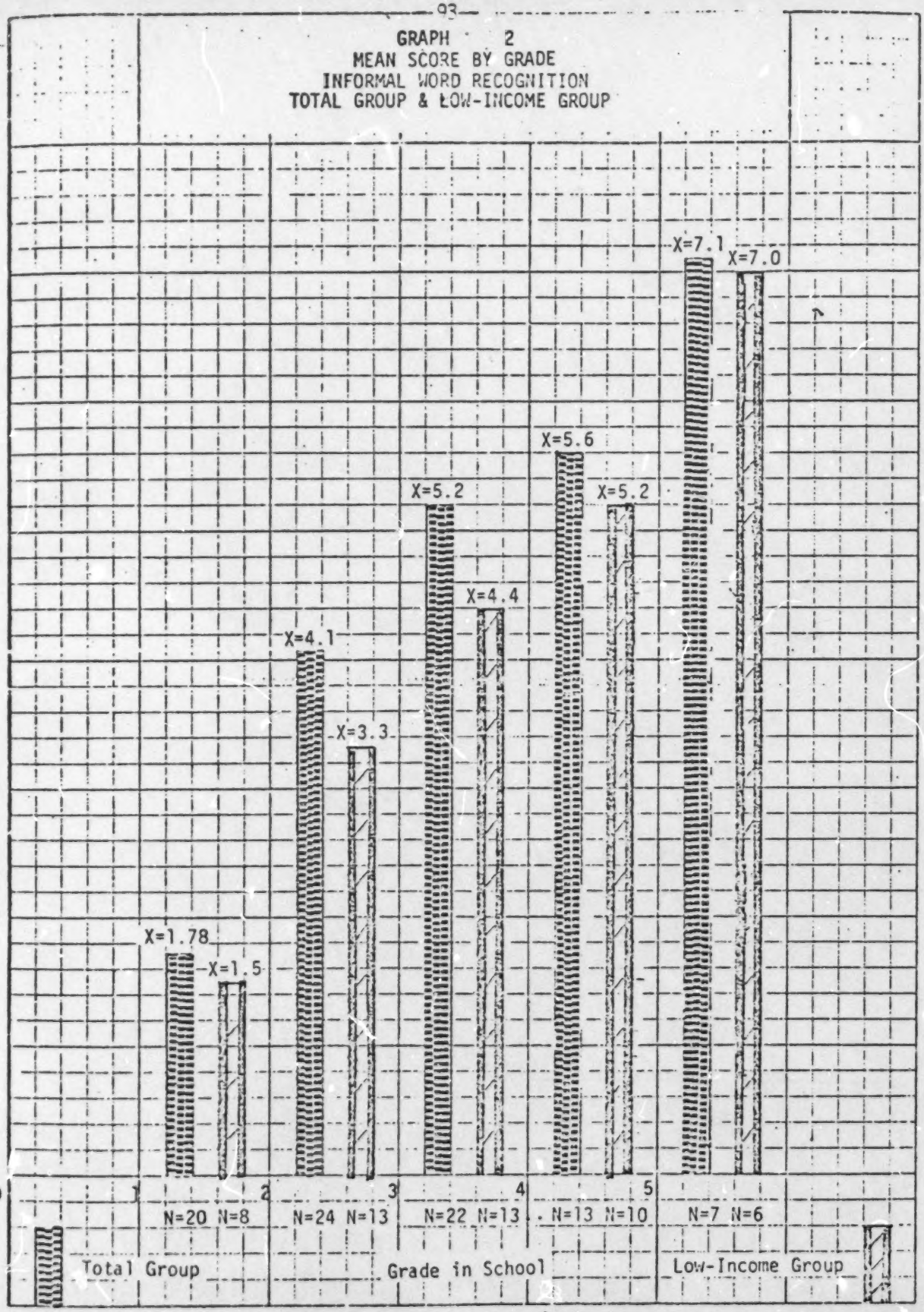
The descriptive picture of the reading progress of the SCILS children is presented in graphs 1, 2, 3, 4, and 5. These graphs show that the total group (middle and low income), the low income group, and the high risk low income group continue to make progress in reading achievement during their

elementary years. Not only is progress maintained, but it is maintained at or above grade level. Thus the regression in reading achievement scores which so often occurs after the third grade is not reflected in the descriptive data. Rather, the opposite appears to occur, growth is maintained.

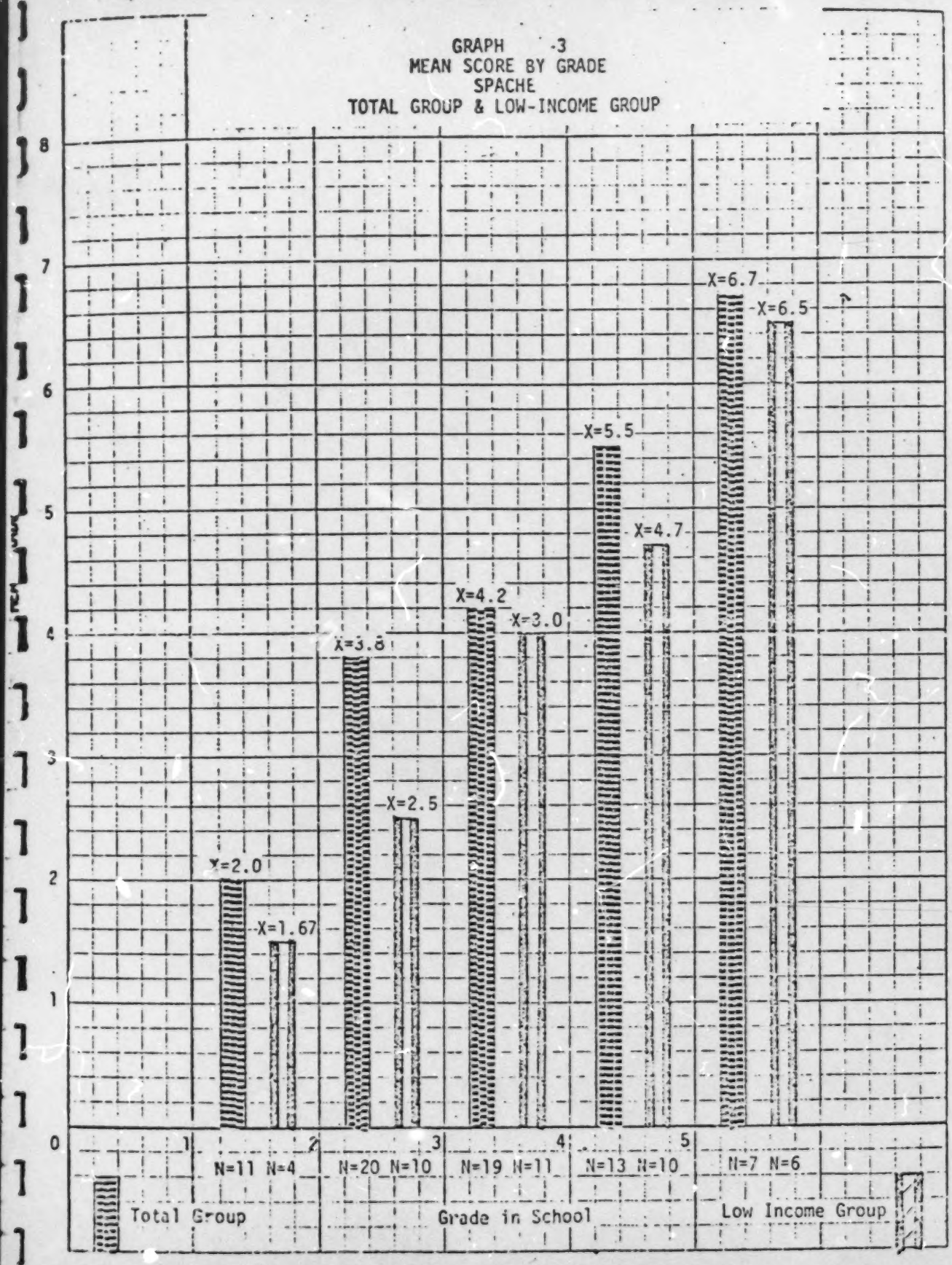
GRAPH 1
MEAN SCORE BY GRADE
WIDE RANGE READING
TOTAL SCILS GROUP & LOW INCOME GROUP

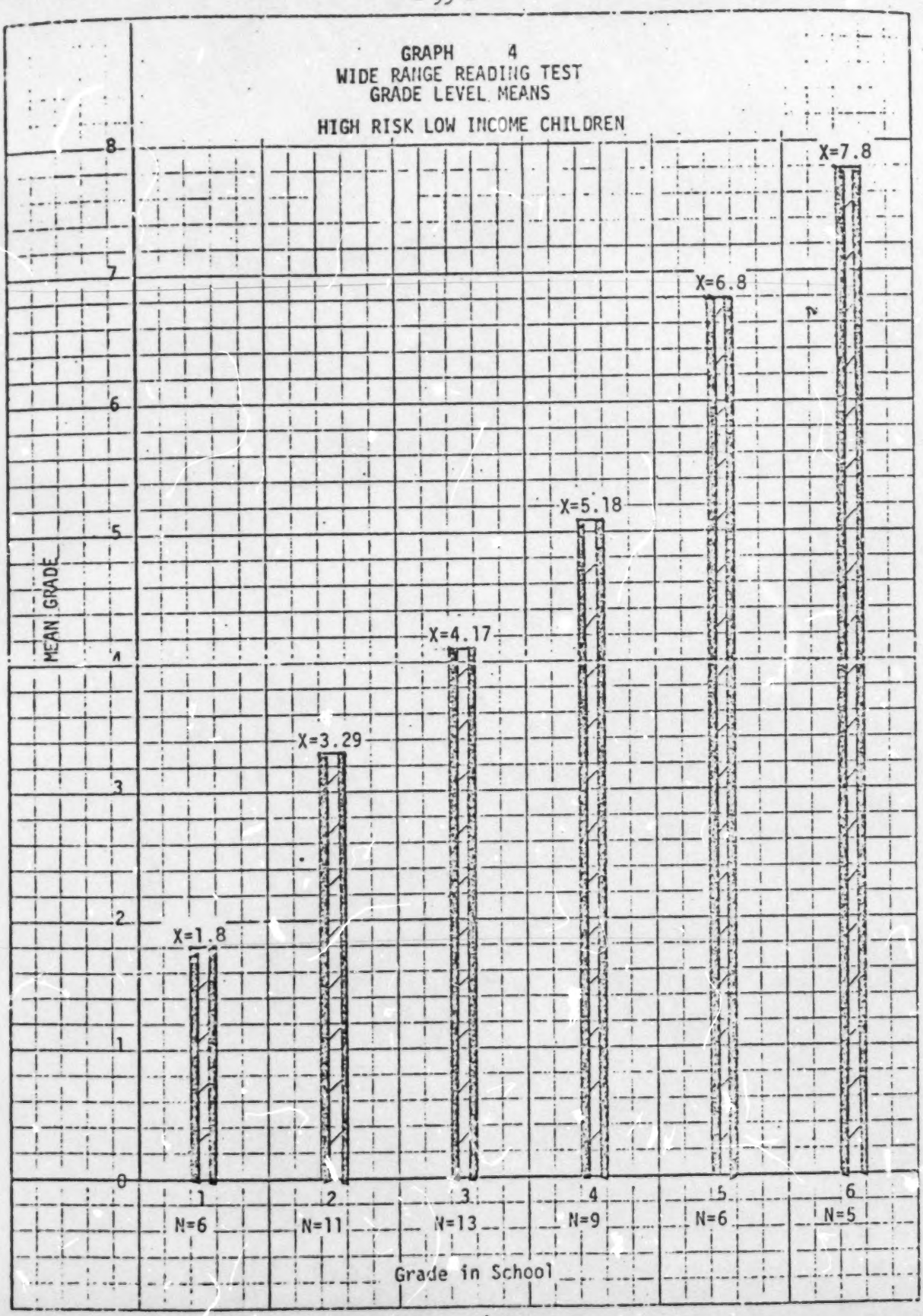


GRAPH 2
MEAN SCORE BY GRADE
INFORMAL WORD RECOGNITION
TOTAL GROUP & LOW-INCOME GROUP



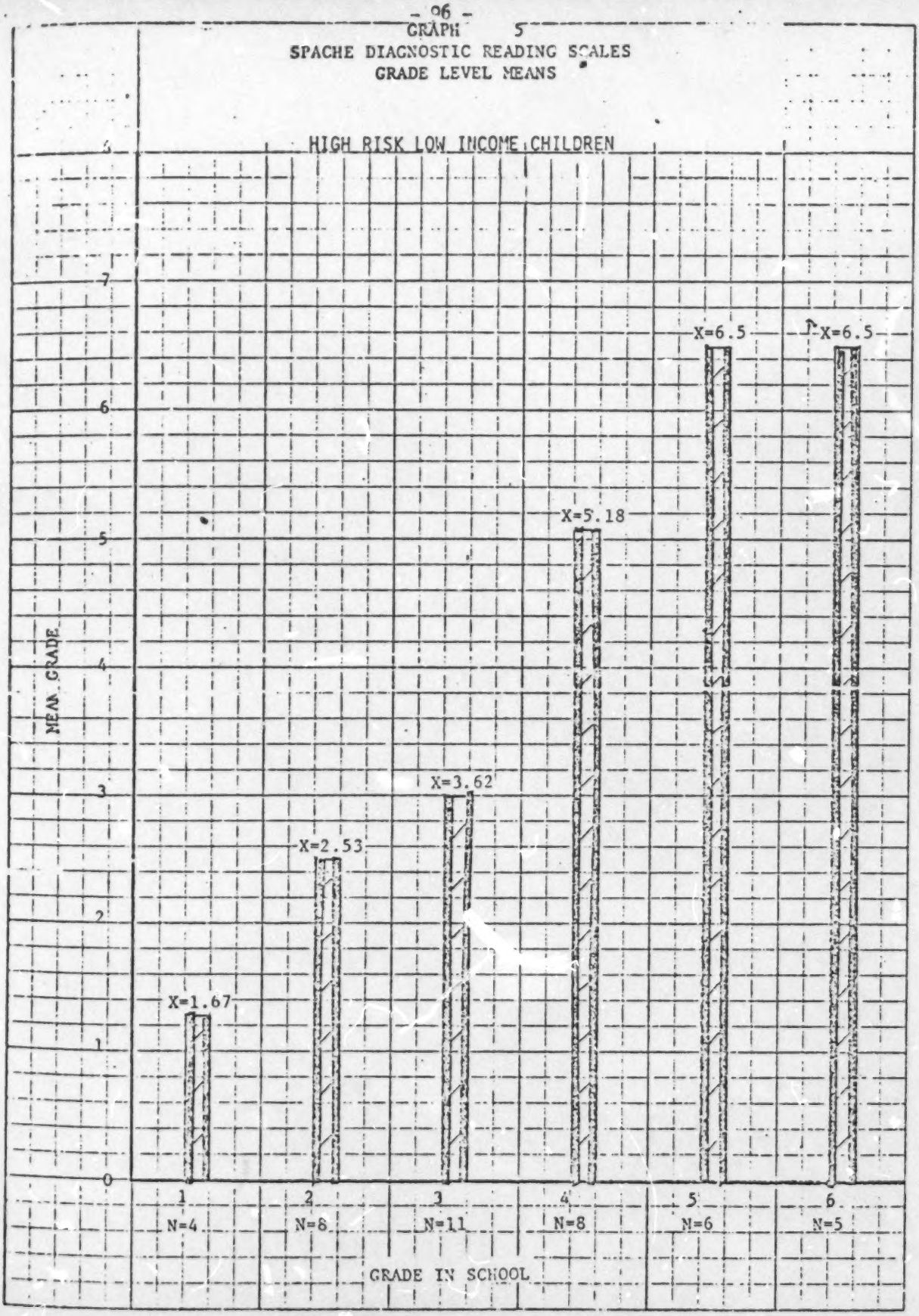
GRAPH -3
MEAN SCORE BY GRADE
SPACHE
TOTAL GROUP & LOW-INCOME GROUP




GRAPH 4
WIDE RANGE READING TEST
GRADE LEVEL MEANS
HIGH RISK LOW INCOME CHILDREN
MEAN GRADE
8
7
6
5
4
3
2
1
0
X=1.8
X=3.29
X=4.17
X=5.18
X=6.8
X=7.8
1
2
3
4
5
6
N=6
N=11
N=13
N=9
N=6
N=5
Grade in School

GRAPH 5

SPACHE DIAGNOSTIC READING SCALES
GRADE LEVEL MEANS



RESULTS OF MULTIVARIATE ANALYSIS

Through a variety of statistical techniques, ranging from descriptive through multivariate regression analysis, the following results were obtained.

Time on Task: All children, regardless of initial IQ, who had 10 hours or more of instructional time in SCILS, are now achieving at or above grade level in word decoding skills (Wide Range Reading Test).

All children, regardless of initial IQ, who received 30 hours or more of instructional time in SCILS are also achieving at or above grade level in reading comprehension and arithmetic (Spache Diagnostic Reading Scales and Wide Range Arithmetic Test).

IQ and Achievement: For the children in SCILS, initial IQ measures do not predict achievement. There is no significant correlation between initial IQ and achievement in reading, thus breaking down the traditional pessimistic prognosis for children with initially low "intelligence" scores.

Achievement gains are sustained beyond the third grade. Nationally, high risk, low SES (Socio-Economic Status) children show a decrease in achievement test scores after third grade. This is not the case with high risk, low SES children who experienced the SCILS program.

The positive correlation of time on SCILS with later achievement increases as the children go through school, an achievement "amplification".

CONCLUSIONS

First of all, it seems as if there is a critical minimum exposure time and time required for reading, arithmetic achievements, and reading comprehension. As noted above all children are at or above grade level in reading achievement.

To date studies from the Philadelphia Board of Education indicate that high risk low socio-economic status (SES) children, consistently regress, year by year, beyond the first grade, in reading achievement and comprehension.

All high risk low SES children who have had what appears to be the critical minimum of thirty hours are all achieving at grade level in reading comprehension as well.

Secondly, it can be stated that the Get-Set children regardless of measured intelligence actually orform on achievement tests at a level comparable to their peers and that this has a significant correlation with their early childhood education and training.

These results provide a basis for advocating expansion of the SCILS program. Future research should 1) serve as a foundation for program development and dissemination; 2) continue but widen the assessment of the impact of SCILS on the individual.

REFERENCES

Chall, Jeanne. Learning to Read—The Great Debate. New York: McGraw Hill Co., 1967.

Campbell, Ruby M. and Guthrie, Larry F. "A Continual Regrouping Program in Reading Readiness Skills for Kindergarten." 1975, ERIC Ed 110 964.

Deutsch, Morton. "The Disadvantaged Child and the Learning Process." Education in Depressed Areas. Edited by A. Harry Passow. New York: Teachers College Columbia University, 1963. pp. 163-179.

Durkin, Dolores Children Who Read Early. New York: Teachers College Press, 1966.

Fischer, Karen M. "Prediction of Reading Ability from Early Language Skills." Sewell: 1975. ERIC Ed 108 128.

Frostig, Marianne and Horne David. The Frostig Program for the Development of Visual Perception. Chicago: Follett Publishing Co., 1964.

Hillerich, Robert L. "Kindergarten Screening Procedures: Early Identification of Labeling?" I.R.A. New York: 1975. ERIC Ed 103 825.

Venezky, Richard L. "Prereading Skills: Theoretical Foundations and Practical Applications." Wisconsin University. Madison: 1975, ERIC Ed 109 663.

Wolpert, Edward M. "Modality and REading: A Perspective." Reading Teacher, 23, April, 1971.

APPENDIX A

OVERALL REGRESSION TABLES

Grades 1 through 4

A-1

		MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
RETIME	21	1553.00000000	907.66248138	32613.00000000	373.00000000	3908.00000000
FULLISC	21	100.85714286	14.44928106	2118.00000000	82.00000000	126.00000000
ECCMOS	12	23.50000000	9.70334686	282.00000000	9.00000000	34.00000000
WRR	20	39.20000000	11.36291290	784.00000000	22.00000000	58.00000000
WRA	20	22.95000000	3.63426674	459.00000000	9.00000000	27.00000000
SES	16	0.56250000	0.51234754	9.00000000	0	1.00000000
IWR	19	1.78947368	1.54843819	34.00000000	0	5.00000000
SPACHE	11	2.02727236	1.43434388	22.29999600	0	4.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
RETIME	1.00000 0.0000 21	-0.10583 0.6480 21	0.45229 0.1399 12	0.25535 0.2772 20	0.26405 0.2606 20	-0.25760 0.3354 16	0.28110 0.2437 19	0.11014 0.7472 11
FULLISC	-0.10583 0.6480 21	1.00000 0.0000 21	-0.03165 0.9222 12	0.46237 0.0401 20	0.02645 0.9118 20	-0.59072 0.0160 16	0.51985 0.0225 19	0.62803 0.0385 11
ECCMOS	0.45229 0.1399 12	-0.03165 0.9222 12	1.00000 0.0000 12	-0.19301 0.5478 12	0.26705 0.4014 12	0.11830 0.7142 12	0.26195 0.4108 12	0.06303 0.8932 7
WRR	0.25535 0.2772 20	0.46237 0.0401 20	-0.19301 0.5478 12	1.00000 0.0000 20	0.50623 0.0226 20	-0.57891 0.0188 16	0.81384 0.0001 18	0.74790 0.0129 10
WRA	0.26405 0.2606 20	0.02645 0.9118 20	0.26705 0.4014 12	0.50623 0.0226 20	1.00000 0.0000 20	-0.35694 0.1747 16	0.49756 0.0356 18	0.39089 0.2640 10
SES	-0.25760 0.3354 16	-0.59072 0.0160 16	0.11830 0.7142 12	-0.57891 0.0188 16	-0.35694 0.1747 16	1.00000 0.0000 16	-0.52566 0.0442 15	-0.37668 0.3177 9
IWR	0.28110 0.2437 19	0.51985 0.0225 19	0.26195 0.4108 12	0.81384 0.0001 18	0.49756 0.0356 18	-0.52566 0.0442 15	1.00000 0.0000 19	0.87857 0.0004 11

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
SPACHE	0.11014 0.7472 11	0.62803 0.0385 11	0.06303 0.8932 7	0.74790 0.0129 10	0.39089 0.2640 10	-0.37668 0.3177 9	0.87857 0.0004 11	1.00000 0.0000 11

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE WAR

[illegible] 9 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 1 VARIABLE FULLISC ENTERED R SQUARE = 0.83277113

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	990.45492334	990.45492334	51.44	0.0001
ERROR	10	191.[illegible]507666	19.17950767		
TOTAL	11	1182.2[illegible]000000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-33.47991796				
FULLISC	0.80101490	0.11166588	990.45492334	51.64	0.0001

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE ECONOS ENTERED R SQUARE = 0.8[illegible]

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1022.[illegible]	511.15041983	28.76	0.0001
ERROR	9	159.[illegible]	17.77212893		
TOTAL	11	1182.[illegible]			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-28.92291661				
ECONOS	-0.17549885	0.1[illegible]	31.86591631	1.79	0.2135
FULLISC	0.79666732	0.1[illegible]	978.26801860	55.04	0.0001

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE RETIME ENTERED R SQUARE = 0.91[illegible]

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1083.[illegible]	361.14661298	29.24	0.0001
ERROR	8	98.[illegible]	12.35134513		
TOTAL	11	1182.2[illegible]			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-31.36[illegible]				
RETIME	0.00236356	0.[illegible]	61.13839328	4.95	0.0564
ECONOS	-0.29891567	0.1[illegible]	73.36257110	5.94	0.0407
FULLISC	0.81015304	0.0[illegible]	1007.40666061	81.56	0.0001

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
RETIME	9	132e.0000[illegible]000	107e.3427[illegible]047	11952.00000000	373.00000000	3908.00000000
FULLISC	9	91.88888889	9.5983C064	827.00000000	82.00000000	108.00000000
ECCMOS	7	24.42857143	8.9221C056	171.00000000	16.00000000	34.00000000
WRR	9	34.66666667	10.14889157	312.00000000	22.00000000	53.00000000
WRA	9	21.66666667	4.89397949	195.00000000	9.00000000	25.00000000
SES	9	1.00000000	0	9.00000000	1.00000000	1.00000000
IWR	8	1.50000000	1.41421356	12.00000000	0	4.00000000
SPACHE	4	1.67499950	1.51299874	6.69999800	0.30000000	3.79999900

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
RETIME	1.00000	-0.29298	0.49522	0.19182	0.23263	0.00000	0.48495	-0.03888
	0.0000	0.4442	0.2585	0.6210	0.5469	1.0000	0.2232	0.9611
	9	9	7	9	9	9	8	4
FULLISC	-0.29298	1.00000	-0.66536	0.33074	-0.53211	0.00000	0.47841	0.94537
	0.4442	0.0000	0.1029	0.3847	0.1403	1.0000	0.2305	0.0546
	9	9	7	9	9	9	8	4
ECCMOS	0.49522	-0.66536	1.00000	-0.47904	0.25606	0.00000	0.11160	-0.73476
	0.2585	0.1029	0.0000	0.2768	0.5794	1.0000	0.8117	0.2652
	7	7	7	7	7	7	7	4
WRR	0.19182	0.33074	-0.47904	1.00000	0.54808	0.00000	0.68482	0.92834
	0.6210	0.3847	0.2768	0.0000	0.1266	1.0000	0.0609	0.0717
	9	9	7	9	9	9	8	4
WRA	0.23263	-0.53211	0.25606	0.54808	1.00000	0.00000	0.55168	0.60582
	0.5469	0.1403	0.5794	0.1266	0.0000	1.0000	0.1563	0.3942
	9	9	7	9	9	9	8	4
SES	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	9	9	7	9	9	9	8	4
IWR	0.48495	0.47841	0.11160	0.68482	0.55168	0.00000	1.00000	0.93633
	0.2232	0.2305	0.8117	0.0609	0.1563	1.0000	0.0000	0.0637
	8	8	7	8	8	8	8	4

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
SPACHE	-0.03888	0.94537	-0.73476	0.92834	0.60582	0.00000	0.93633	1.00000
	0.9611	0.0546	0.2652	0.0717	0.3942	1.0000	0.0637	0.0000
	4	4	4	4	4	4	4	4

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE MAR

WARNING: 2 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 3 VARIABLE FULLISC ENTERED R SQUARE = 0.92211313

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	521.65296804	521.65296804	59.20	0.0006
ERROR	5	44.06135768	8.81226354		
TOTAL	6	565.71432571			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-60.79060665				
FULLISC	1.09132420	0.14181260	521.65296804	59.20	0.0006

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 4 VARIABLE ALTIME ENTERED R SQUARE = 0.97473738

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	551.42819761	275.71359880	77.17	0.0004
ERROR	4	14.29132811	3.57283203		
TOTAL	6	565.71432571			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-68.67567330				
ALTIME	0.03192916	0.00366831	29.77022957	8.33	0.0447
FULLISC	1.14606909	0.09256426	551.09000682	154.25	0.0002

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 5 VARIABLE PCCMOS ENTERED R SQUARE = 0.98843951

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	559.17633097	186.39145032	85.50	0.0021
ERROR	3	6.53793479	2.17997825		
TOTAL	6	565.71432571			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-83.66956273				
ALTIME	0.00137825	0.00359823	11.57087560	5.31	0.1046
PCCMOS	0.23521446	0.13383059	7.75115337	3.56	0.1554
FULLISC	1.26687572	0.09519613	378.10049717	173.44	0.0009

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
RETIME	24	1659.91666667	767.17024903	39838.00000000	373.00000000	3492.00000000
FULLISC	17	103.11764706	21.42394201	1753.00000000	68.00000000	144.00000000
ECCMCS	21	24.76190476	8.30002869	520.00000000	7.00000000	34.00000000
WRR	24	54.66666667	9.61731936	1312.00000000	28.00000000	70.00000000
WRA	24	26.95833333	2.17653827	647.00000000	23.00000000	33.00000000
SES	21	3.61904762	3.49761335	13.00000000	0	1.00000000
IWR	24	4.16666667	1.83346281	100.00000000	1.00000000	7.00000000
SPACHE	20	3.81499990	1.94622068	76.29999800	0.30000000	6.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMCS	WRR	WRA	SES	IWR	SPACHE
RETIME	1.00000	-0.05626	0.35061	0.20776	0.12941	-0.17171	0.30253	-0.34783
	0.0000	0.8302	0.1192	0.3300	0.5467	0.4567	0.1507	0.1329
	24	17	21	24	24	21	24	20
FULLISC	-0.05626	1.00000	-0.21427	0.64935	0.69903	-0.75980	0.71494	0.92332
	0.8302	0.0000	0.4089	0.0048	0.0018	0.0004	0.0013	0.0001
	17	17	17	17	17	17	17	13
ECCMCS	0.35061	-0.21427	1.00000	0.27392	0.19307	-0.08359	0.24260	-0.04097
	0.1192	0.4089	0.0000	0.2295	0.4017	0.7187	0.2893	0.8759
	21	17	21	21	21	21	21	17
WRR	0.20776	0.64935	0.27392	1.00000	0.66189	-0.46742	0.87606	0.70853
	0.3300	0.0048	0.2295	0.0000	0.0004	0.0326	0.0001	0.0005
	24	17	21	24	24	21	24	20
WRA	0.12941	0.69903	0.19307	0.66189	1.00000	-0.57753	0.61188	0.56696
	0.5467	0.0018	0.4017	0.0004	0.0000	0.0061	0.0015	0.0091
	24	17	21	24	24	21	24	20
SES	-0.17171	-0.75980	-0.08359	-0.46742	-0.57753	1.00000	-0.51995	-0.71982
	0.4567	0.0004	0.7187	0.0326	0.0061	0.0000	0.0157	0.0011
	21	17	21	21	21	21	21	17
IWR	0.30253	0.71494	0.24260	0.87606	0.61188	-0.51995	1.00000	0.63537
	0.1507	0.0013	0.2893	0.0001	0.0015	0.0157	0.0000	0.0026
	24	17	21	24	24	21	24	20

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMCS	WRR	WRA	SES	IWR	SPACHE
SPACHE	-0.34783	0.92332	-0.04097	0.70853	0.56696	-0.71982	0.63537	1.00000
	0.1329	0.0001	0.8759	0.0005	0.0091	0.0011	0.0026	0.0000
	20	13	17	20	20	17	20	20

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE VAR

WARNING: 7 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 1 VARIABLE FULLESC ENTERED R SQUARE = 0.42165205

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	858.93002279	858.93002279	10.94	0.0048
ERROR	15	1178.12660076	78.54192005		
TOTAL	16	2037.05662353			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	18.98959465				
FULLESC	0.34199481	0.10341687	858.93002279	10.94	0.0048

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE ECONOS ENTERED R SQUARE = 0.58616187

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1194.14020130	597.02310065	9.91	0.0021
ERROR	14	843.01262223	60.21518730		
TOTAL	16	2037.05662353			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-1.11532951				
ECONOS	0.61737471	0.24170026	335.11617851	5.57	0.0334
FULLESC	0.38835523	0.09270419	1059.45661050	17.59	0.0009

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE METTIME ENTERED R SQUARE = 0.59674430

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1215.[illegible]	405.20100286	6.41	0.0067
ERROR	13	821.[illegible]	63.18889038		
TOTAL	16	2037.05662353			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-2.14031843				
METTIME	0.00145963	0.00249868	21.55704724	0.34	0.5697
ECONOS	0.55210026	0.[illegible]	239.54629594	3.79	0.0731
FULLESC	0.38762683	0.09498520	1052.21980246	16.65	0.0013

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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VARIABLE	N	MEAN	STD	SUM	MIN	MAX
RETIME	13	1573.76923077	799.37466746	20459.00000000	373.00000000	3318.00000000
FULLISC	11	81.45454545	15.32955718	1006.00000000	68.00000000	123.00000000
ECCMOS	13	24.23076923	8.04315245	315.00000000	7.00000000	34.00000000
WRR	13	50.69230769	10.99533731	659.00000000	28.00000000	66.00000000
WRA	13	25.84615385	1.34450468	336.00000000	23.00000000	28.00000000
SES	13	1.00000000	0	13.00000000	1.00000000	1.00000000
IWR	13	3.38461538	1.80429265	44.00000000	1.00000000	6.00000000
SPACHE	10	2.54999980	1.83538532	25.49999800	0.30000000	5.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
RETIME	1.00000 0.0000 13	-0.23386 0.4889 11	0.44369 0.1288 13	0.23961 0.4304 13	0.20668 0.4981 13	0.00000 1.0000 13	0.36765 0.2165 13	-0.55146 0.0984 10
FULLISC	-0.23386 0.4889 11	1.00000 0.0000 11	-0.16653 0.6246 11	0.50052 0.1169 11	0.53086 0.1166 11	0.00000 1.0000 11	0.46893 0.1457 11	0.93644 0.0006 8
ECCMOS	0.44369 0.1288 13	-0.16653 0.6246 11	1.00000 0.0000 13	0.35329 0.2364 13	0.21933 0.4716 13	0.00000 1.0000 13	0.52159 0.0675 13	-0.16317 0.6524 10
WRR	0.23961 0.4304 13	0.50052 0.1169 11	0.35329 0.2364 13	1.00000 0.0000 13	0.71807 0.0057 13	0.00000 1.0000 13	0.88644 0.0001 13	0.61360 0.0592 10
WRA	0.20668 0.4981 13	0.53086 0.1166 11	0.21933 0.4716 13	0.71807 0.0057 13	1.00000 0.0000 13	0.00000 1.0000 13	0.67401 0.0107 13	0.45144 0.1903 10
SES	0.00000 1.0000 13	0.00000 1.0000 11	0.00000 1.0000 13	0.00000 1.0000 13	0.00000 1.0000 13	0.00000 1.0000 13	0.00000 1.0000 13	0.00000 1.0000 10
IWR	0.36765 0.2165 13	0.46893 0.1457 11	0.52159 0.0675 13	0.88644 0.0001 13	0.67401 0.0107 13	0.00000 1.0000 13	1.00000 0.0000 13	0.46456 0.1762 10

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WRR	WRA	SES	IWR	SPACHE
SPACHE	-0.55146 0.0984 10	0.93644 0.0006 8	-0.16317 0.6524 10	0.61360 0.0592 10	0.45144 0.1903 10	0.00000 1.0000 10	0.46456 0.1762 10	1.00000 0.0000 10

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE GAS

WARNING: 2 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 1 VARIABLE FULLTSC ENTERED R SQUARE = 0.25052435

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	352.64637571	352.64637571	3.01	0.1169
ERROR	9	1054.97178792	117.22213199		
TOTAL	10	1407.61816364			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	14.74477473				
FULLTSC	0.38748258	0.22340199	352.64637571	3.01	0.1169

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE ECONOS ENTERED R SQUARE = 0.53447.97

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	752.61922296	376.17461148	4.59	0.0470
ERROR	8	655.23716368	81.91089258		
TOTAL	10	1407.61636364			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-15.97065768				
ECONOS	0.95292514	0.43133990	399.70484725	4.88	0.0502
FULLTSC	0.49315574	0.13939213	477.25020872	5.83	0.0423

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE RETIME ENTERED R SQUARE = 0.59647385

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	839.61823679	279.87273560	3.45	0.0804
ERROR	7	568.01815685	81.14545098		
TOTAL	10	1437.61636364			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-21.73657657				
RETIME	0.00397068	0.00382665	87.26898383	1.08	0.3342
ECONOS	0.76321104	0.43949649	235.75920379	2.91	0.1321
FULLTSC	0.49936382	0.13488925	538.58765815	6.64	0.0367

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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RETIME	22	1[illegible].32727273	940.95965347	34594.00000000	373.00000000	3979.00000000
FULLISC	17	106.82352941	18.3413307[illegible]	1816.00000000	80.00000000	138.00000000
ECCMOS	22	24.50000000	6.80617534	539.00000000	9.00000000	35.00000000
WHR	22	61.63636364	13.31860655	1356.00000000	28.00000000	82.00000000
WRA	22	29.68181818	3.06106677	653.00000000	22.00000000	34.00000000
SES	22	0.59090909	0.50323628	13.00000000	0	1.00000000
IWR	22	5.27272727	2.11778928	116.00000000	0	8.00000000
SPACHE	19	4.22631579	2.37115084	80.30000000	0	7.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WHR	WRA	SES	IWR	SPACHE
RETIME	1.00000 0.0000 22	0.15326 0.5570 17	0.47811 0.0244 22	0.17337 0.4464 22	0.02105 0.9259 22	-0.10131 0.6537 22	0.27926 0.2082 22	-0.17348 0.4647 19
FULLISC	0.15326 0.5570 17	1.00000 0.0000 17	0.14207 0.5865 17	0.63555 0.0061 17	0.76584 0.0003 17	-0.72468 0.0010 17	0.67221 0.0031 17	0.93010 0.0001 14
ECCMOS	0.47811 0.0244 22	0.14207 0.5865 17	1.00000 0.0000 22	0.12033 0.5934 22	0.24777 0.2662 22	0.17574 0.4340 22	0.26550 0.2324 22	-0.03747 0.8789 19
WHR	0.17337 0.4464 22	0.63555 0.0061 17	0.12033 0.5934 22	1.00000 0.0000 22	0.69550 0.0003 22	-0.44954 0.0356 22	0.92123 0.0001 22	0.73345 0.0004 19
WRA	0.02105 0.9259 22	0.76584 0.0003 17	0.24777 0.2662 22	0.69550 0.0003 22	1.00000 0.0000 22	-0.39765 0.0668 22	0.74053 0.0001 22	0.87170 0.0001 19
SES	-0.10131 0.6537 22	-0.72468 0.0010 17	0.17574 0.4340 22	-0.44954 0.0356 22	-0.39765 0.0668 22	1.00000 0.0000 22	-0.47074 0.0270 22	-0.60412 0.0062 19
IWR	0.27926 0.2082 22	0.67221 0.0031 17	0.26550 0.2324 22	0.92123 0.0001 22	0.74053 0.0001 22	-0.47074 0.0270 22	1.00000 0.0000 22	0.766[illegible] 0.0001 19

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WHR	WRA	SES	IWR	SPACHE
SPACHE	-0.17348 0.4647 19	0.93010 0.0001 14	-0.03747 0.8789 19	0.73345 0.0004 19	0.87170 0.0001 19	-0.60412 0.0062 19	0.76673 0.0001 19	1.00000 0.0000 19

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE WAR

[illegible] 5 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 1 VARIABLE FULLISC ENTERED R SQUARE = 0.43352320

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	1162.87137472	1162.87137472	10.16	0.0061
ERROR	15	1716.03980175	114.40465345		
TOTAL	16	2878.91117647			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	9.28058386				
FULLISC	0.46180951	0.14479810	1162.87137472	10.16	0.0061

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE RETIME ENTERED R SQUARE = 0.49806413

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1410.84221469	705.40610734	6.73	0.0090
ERROR	14	1468.13296178	104.86664013		
TOTAL	16	2878.91117647			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	5.18371088				
RETIME	0.03197545	0.00256564	247.93683997	2.36	0.1464
FULLISC	0.43152263	0.14123026	978.73693938	9.33	0.0086

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE ECONOS ENTERED R SQUARE = 0.51326505

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1477.65587402	492.55529134	4.57	0.0214
ERROR	13	1401.26133245	107.79386942		
TOTAL	16	2878.91117647			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-0.20881254				
RETIME	0.00280384	0.00231400	93.28336577	0.87	0.3692
ECONOS	0.31729701	0.40298135	66.85165933	0.62	0.4451
FULLISC	0.42254023	0.14362018	934.77916186	8.67	0.0114

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
RETIME	13	1722.23076923	755.43362439	22389.00000000	373.00000000	3310.00000000
FULLISC	12	98.50000000	14.65667704	1182.00000000	80.00000000	129.00000000
ECCMOS	13	25.76923077	6.63512230	335.00000000	16.00000000	34.00000000
WAR	13	56.76923077	13.59015481	738.00000000	28.00000000	75.00000000
WRA	13	28.69230769	5.52399928	373.00000000	22.00000000	34.00000000
SES	13	1.00000000	0	13.00000000	1.00000000	1.00000000
IWR	13	4.46153846	2.25888559	58.00000000	0	7.00000000
SPACHE	11	3.02727273	2.39753661	33.30000000	0	7.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WAR	WRA	SES	IWR	SPACHE
RETIME	1.00000	-0.36492	0.32414	0.17268	-0.23829	0.00000	0.14136	-0.36492
	0.0000	0.2698	0.2799	0.5727	0.4330	1.0000	0.6451	0.2698
	13	12	13	13	13	13	13	11
FULLISC	-0.36492	1.00000	0.13722	0.56867	0.77986	0.00000	0.52373	0.93720
	0.2698	0.0000	0.6766	0.0537	0.0028	1.0000	0.0805	0.0001
	12	12	12	12	12	12	12	10
ECCMOS	0.32414	0.13722	1.00000	0.43186	0.31774	0.00000	0.44694	0.12055
	0.2799	0.6706	0.0000	0.1406	0.2901	1.0000	0.1257	0.7249
	13	12	13	13	13	13	13	11
WAR	0.17268	0.56867	0.43186	1.00000	0.68107	0.00000	0.92943	0.70765
	0.5727	0.0537	0.1406	0.0000	0.0104	1.0000	0.0001	0.0148
	13	12	13	13	13	13	13	11
WRA	-0.23829	0.77986	0.31774	0.68107	1.00000	0.00000	0.68990	0.88804
	0.4330	0.0028	0.2901	0.0104	0.0000	1.0000	0.0091	0.0003
	13	12	13	13	13	13	13	11
SES	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	13	12	13	13	13	13	13	11
IWR	0.14136	0.52373	0.44694	0.92943	0.68990	0.00000	1.00000	0.74358
	0.6451	0.0805	0.1257	0.0001	0.0091	1.0000	0.0000	0.0087
	13	12	13	13	13	13	13	11

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CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / NUMBER OF OBSERVATIONS

	RETIME	FULLISC	ECCMOS	WAR	WRA	SES	IWR	SPACHE
SPACHE	-0.36492	0.93720	0.12055	0.70765	0.88804	0.00000	0.74358	1.00000
	0.2698	0.0001	0.7249	0.0148	0.0003	1.0000	0.0087	0.0000
	11	10	11	11	11	11	11	11

MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE MPG

WARNING: 3 OBSERVATIONS DELETED DUE TO MISSING VALUES.

STEP 1 VARIABLE ECONOS ENTERED R SQUARE = 0.35370293

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	751.26495391	751.26495391	5.47	0.0414
ERROR	10	1372.73504609	137.27350461		
TOTAL	11	2124.00000000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	20.65287311				
ECONOS	1.32967248	0.56838452	751.26495391	5.47	0.0414

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE FULLESC ENTERED R SQUARE = 0.59564387

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1264.[illegible]	632.40387438	6.62	0.0170
ERROR	9	859.[illegible]	95.46580569		
TOTAL	11	2124.00000000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-21.65618773				
ECONOS	1.17737836	[illegible]	577.93682198	6.05	0.0361
FULLESC	0.47063499	0.20291764	513.54279685	5.38	0.0455

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE ACCEPT ENTERED R SQUARE = 0.64423151

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1368.39773948	456.13591183	4.83	0.0333
ERROR	8	755.60226052	94.45653306		
TOTAL	11	2124.00000000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	-33.67750421				
ACCEL	0.00461357	0.00440694	103.53998672	1.10	0.3257
ECONOS	0.94401561	0.52538622	304.72101249	3.23	0.1102
FULLESC	0.57457895	0.22493722	616.32356375	6.52	0.0334

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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[illegible]	N	[illegible]	[illegible]	[illegible]	[illegible]
RETIME	13	1873.07692308	906.89116046	24311.00000000	373.00000000
FULLISC	13	99.76923077	21.74919265	1297.00000000	72.00000000
ECCMOS	13	28.84615385	5.91351232	375.00000000	18.00000000
WAR	13	85.23076923	13.74706398	848.00000000	34.00000000
WRA	13	31.84615385	3.67074365	414.00000000	25.00000000
SES	13	0.76923077	0.43852401	10.00000000	0
IWR	13	5.61538462	1.93814609	73.00000000	0
SPACHE	13	5.50000000	2.35407448	71.50000000	0

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13

	RETIME	FULLISC	ECCMOS	WAR	WRA	SES	IWR	SPACHE
RETIME	1.00000 0.0000	0.34340 0.2507	0.36930 0.1886	0.78592 0.0014	0.38711 0.1913	-0.34108 0.2541	0.67074 0.0121	0.49583 0.0849
FULLISC	0.34340 0.2507	1.00000 0.0000	0.51996 0.0685	0.55339 0.0498	0.64668 0.0169	-0.86231 0.0001	0.42276 0.1501	0.69581 0.0083
ECCMOS	0.36930 0.1886	0.51996 0.0685	1.00000 0.0000	0.74194 0.0037	0.51321 0.0729	-0.36829 0.2156	0.72145 0.0054	0.67340 0.0116
WAR	0.78592 0.0014	0.55339 0.0498	0.74194 0.0037	1.00000 0.0000	0.53881 0.0574	-0.51384 0.0725	0.93850 0.0001	0.74972 0.0021
WRA	0.38711 0.1913	0.64668 0.0169	0.51321 0.0729	0.53881 0.0574	1.00000 0.0000	-0.64512 0.0173	0.42438 0.1484	0.56416 0.0446
SES	-0.34108 0.2541	-0.86231 0.0001	-0.36829 0.2156	-0.51384 0.0725	-0.64512 0.0173	1.00000 0.0000	-0.40727 0.1672	-0.64579 0.0171
IWR	0.67074 0.0121	0.42276 0.1501	0.72145 0.0054	0.93853 0.0001	0.42438 0.1484	-0.40727 0.1672	1.00000 0.0000	0.82191 0.0006
SPACHE	0.49583 0.0849	0.69581 0.0083	0.67340 0.0116	0.76972 0.0021	0.56416 0.0446	-0.64579 0.0171	0.82191 0.0006	1.00000 0.0000

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MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE WAR

STEP 1 VARIABLE AGEFAM ENTERED R SQUARE = 0.61767516

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	1410.96063307	1410.96063307	17.77	0.0016
ERROR	11	873.34735569	79.39516720		
TOTAL	12	2284.30769231			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	42.87080361				
AGEFAM	0.01195671	0.00283629	1410.96063307	17.77	0.0016

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE ECONOS ENTERED R SQUARE = 0.84170408

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1922.72024333	961.36012165	26.59	0.0001
ERROR	10	361.58744931	36.15874493		
TOTAL	12	2284.30769231			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	33.95373660				
AGEFAM	0.00891329	0.00233032	665.26005832	18.40	0.0016
ECONOS	1.19682493	0.31486136	511.75961023	14.15	0.0037

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE PUBLESC ENTERED R SQUARE = 0.85194103

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1946.39721323	648.69907123	17.26	0.0004
ERROR	9	338.21047908	37.57894207		
TOTAL	12	2284.30769231			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	39.61919660				
AGEFAM	0.00860898	0.00215336	608.68502700	15.96	0.0031
ECONOS	1.07096712	0.26355699	326.99418869	8.70	0.0162
PUBLESC	0.07636449	0.09682101	23.37697060	0.62	0.4506

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
AETIME	10	1707.30000000	830.55564400	17073.00000000	373.00000000	3310.00000000
FULLISC	10	89.90000000	12.13305160	899.00000000	72.00000000	112.00000000
ECCMOS	10	27.70000000	6.23698645	277.00000000	18.00000000	34.00000000
WAR	10	61.50000000	12.24364268	615.00000000	34.00000000	79.00000000
WRA	10	30.60000000	2.75680975	306.00000000	25.00000000	36.00000000
SES	10	1.00000000	0	10.00000000	1.00000000	1.00000000
IWR	10	5.20000000	1.98485789	52.00000000	0	7.00000000
SPACHE	10	4.70000000	2.05750658	47.00000000	0	7.50000000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 10

	AETIME	FULLISC	ECCMOS	WAR	WRA	SES	IWR	SPACHE
AETIME	1.00000 0.0000	-0.06887 0.8501	0.36852 0.2947	0.68847 0.0277	0.17301 0.6327	0.00000 1.0000	0.61402 0.0590	0.40637 0.2439
FULLISC	-0.06887 0.8501	1.00000 0.0000	0.45179 0.1899	0.14701 0.6853	0.24117 0.5021	0.00000 1.0000	0.10222 0.7787	0.35919 0.3080
ECCMOS	0.36852 0.2947	0.45179 0.1899	1.00000 0.0000	0.80265 0.0052	0.57384 0.0428	0.00000 1.0000	0.72196 0.0184	0.65025 0.0418
WAR	0.68847 0.0277	0.14701 0.6853	0.80265 0.0052	1.00000 0.0000	0.26341 0.4621	0.00000 1.0000	0.95388 0.0001	0.76588 0.0225
WRA	0.17301 0.6327	0.24117 0.5021	0.57384 0.0428	0.26341 0.4621	1.00000 0.0000	0.00000 1.0000	0.17833 0.6221	0.22135 0.5368
SES	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000	0.00000 1.0000
IWR	0.61402 0.0590	0.10222 0.7787	0.72196 0.0184	0.95388 0.0001	0.17833 0.6221	0.00000 1.0000	1.00000 0.0000	0.80372 0.0051
SPACHE	0.40637 0.2439	0.35919 0.3080	0.65025 0.0418	0.76588 0.0225	0.22135 0.5368	0.00000 1.0000	0.80372 0.0051	1.00000 0.0000

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MAXIMUM R-SQUARE IMPROVEMENT FOR DEPENDENT VARIABLE WAR

STEP 1 VARIABLE ECONUS ENTERED R SQUARE = 0.64424341

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	1	868.75821194	868.75821194	14.49	0.0052
ERROR	8	479.74178806	59.96772351		
TOTAL	9	1348.5000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	17.86518138				
ECONUS	1.57526421	0.41346484	868.75821194	14.49	0.0052

THE ABOVE MODEL IS THE BEST 1 VARIABLE MODEL FOUND.

STEP 2 VARIABLE RETIME ENTERED R SQUARE = 0.82267230

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	2	1109.3794[illegible]4313	554.68707057	16.24	0.0023
ERROR	7	239.[illegible]5[illegible]87	34.16083698		
TOTAL	9	1348.5000[illegible]0000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	25.93508126				
RETIME	0.30669479	0.0[illegible]2330	240.61592919	7.04	0.0328
ECONUS	1.24662428	0.3[illegible]1807	470.19103283	13.76	0.0076

THE ABOVE MODEL IS THE BEST 2 VARIABLE MODEL FOUND.

STEP 3 VARIABLE PULLESC ENTERED R SQUARE = 0.83881165

	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB>F
REGRESSION	3	1131.1[illegible]4104	377.04585369	10.41	0.0086
ERROR	6	217.3[illegible]2892	36.22307315		
TOTAL	9	1348.5000[illegible]0000			

	B VALUE	STD ERROR	TYPE II SS	F	PROB>F
INTERCEPT	25.56413436				
RETIME	0.00613071	0.00270991	183.60545891	5.07	0.0453
ECONUS	1.40755516	0.40354452	440.73870917	12.17	0.0130
PULLESC	-0.14582377	0.1[illegible]3[illegible]3[illegible]5	21.76361995	0.60	0.4677

THE ABOVE MODEL IS THE BEST 3 VARIABLE MODEL FOUND.

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APPENDIX B

SCATTER PLOTS FOR

Grades 1 through 4

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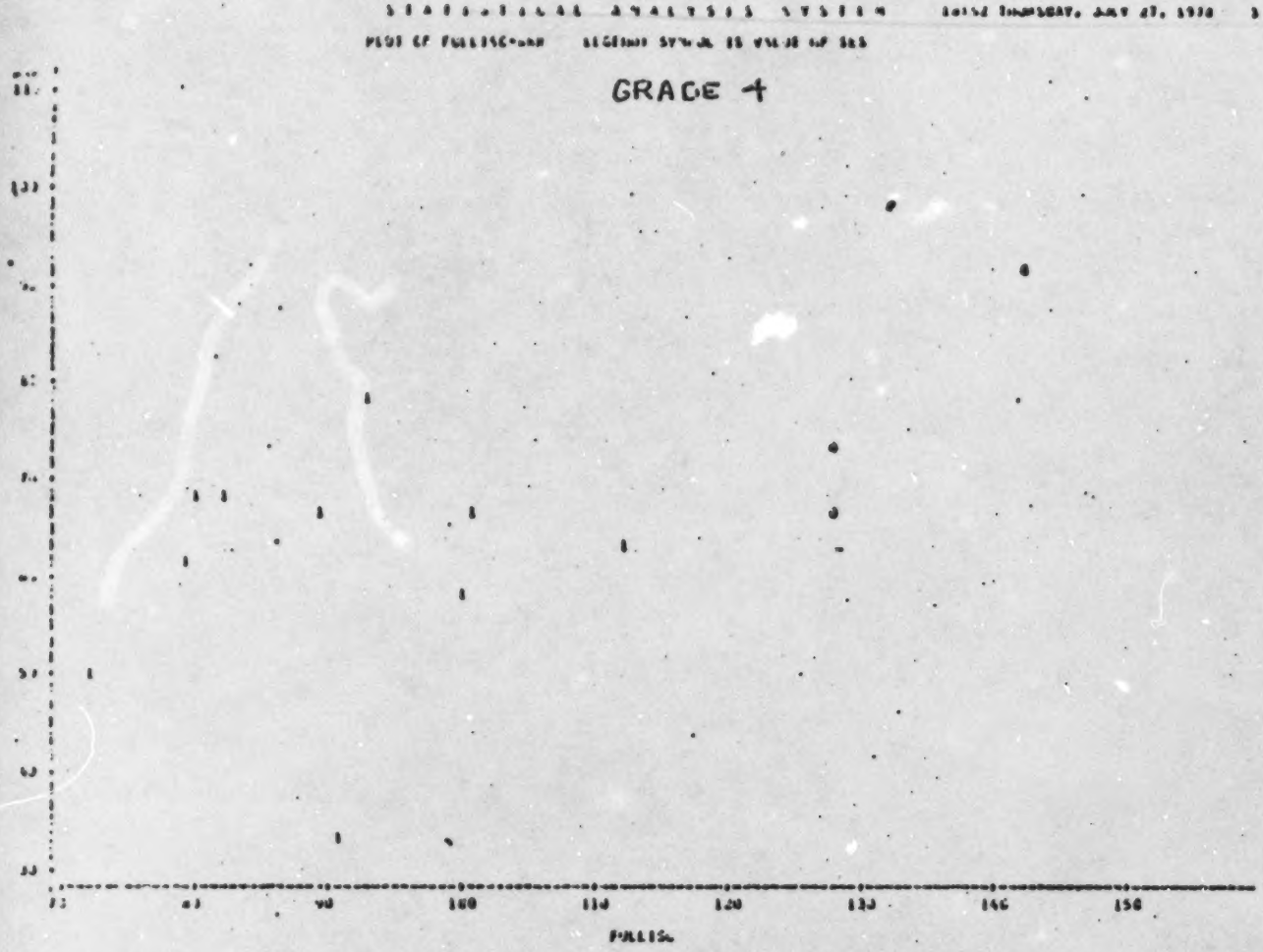

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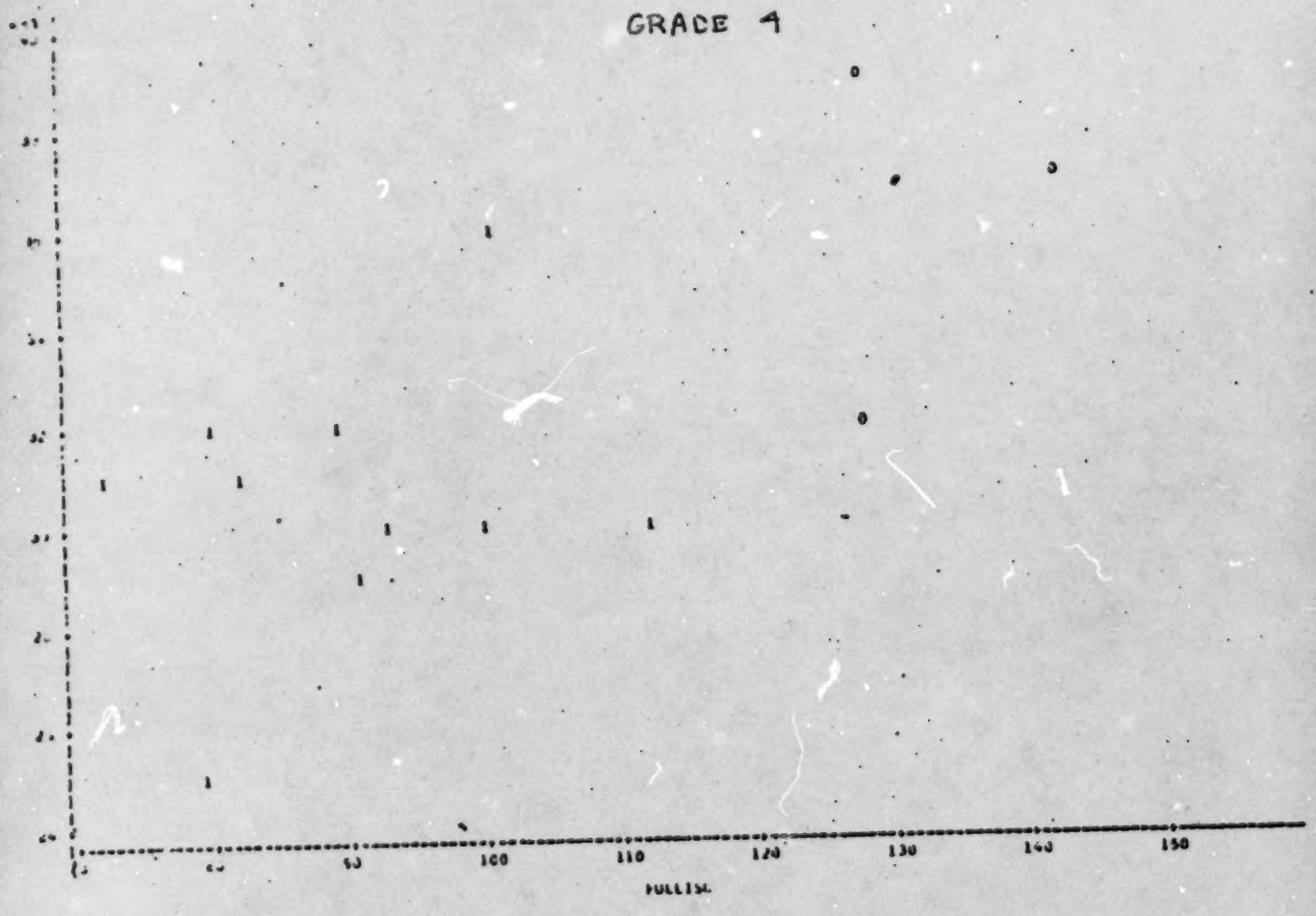
PLOT OF FULLSCORE LEGEND: SYMBOL IS VALUE OF SES

GRACE 4



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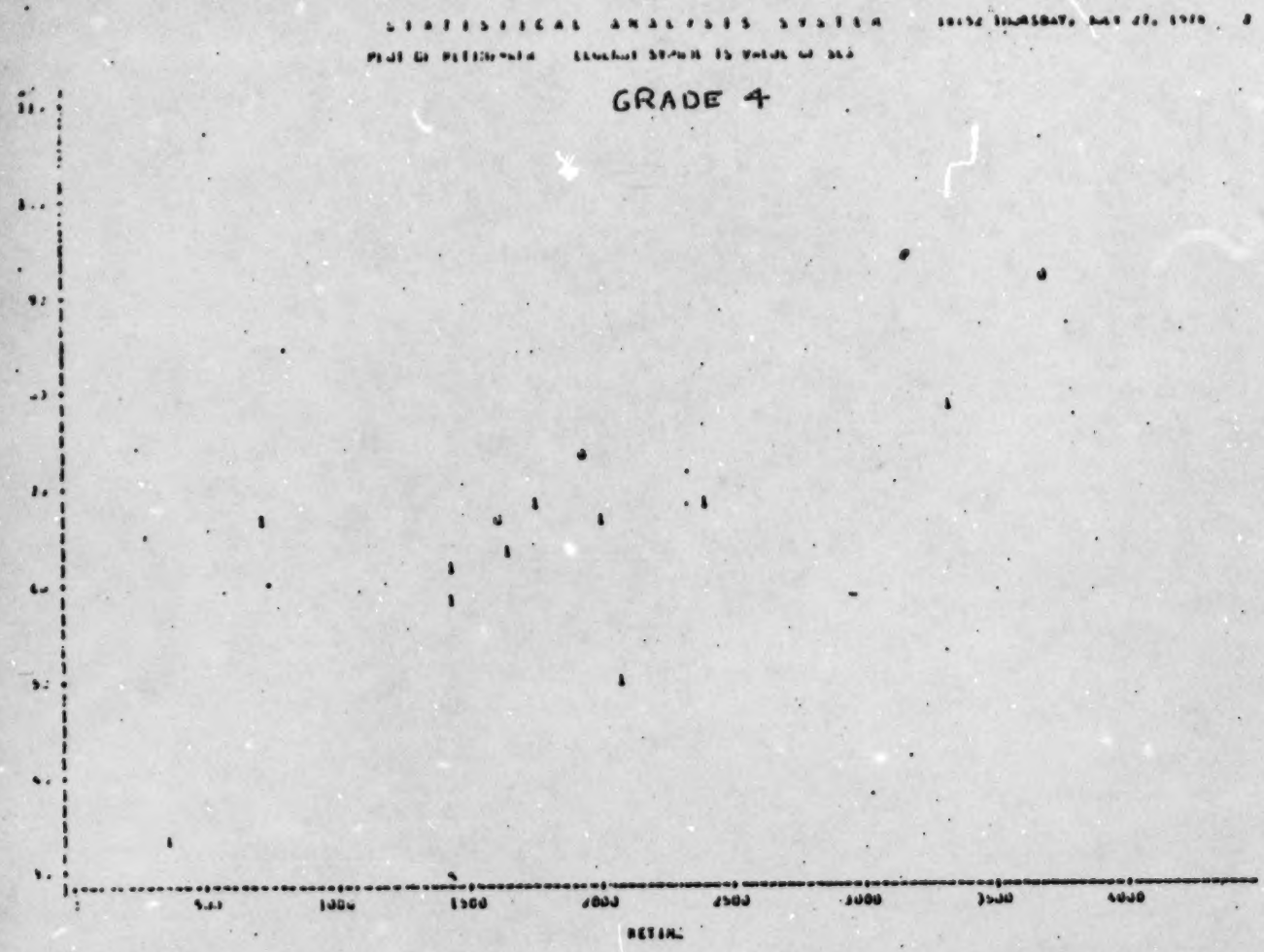

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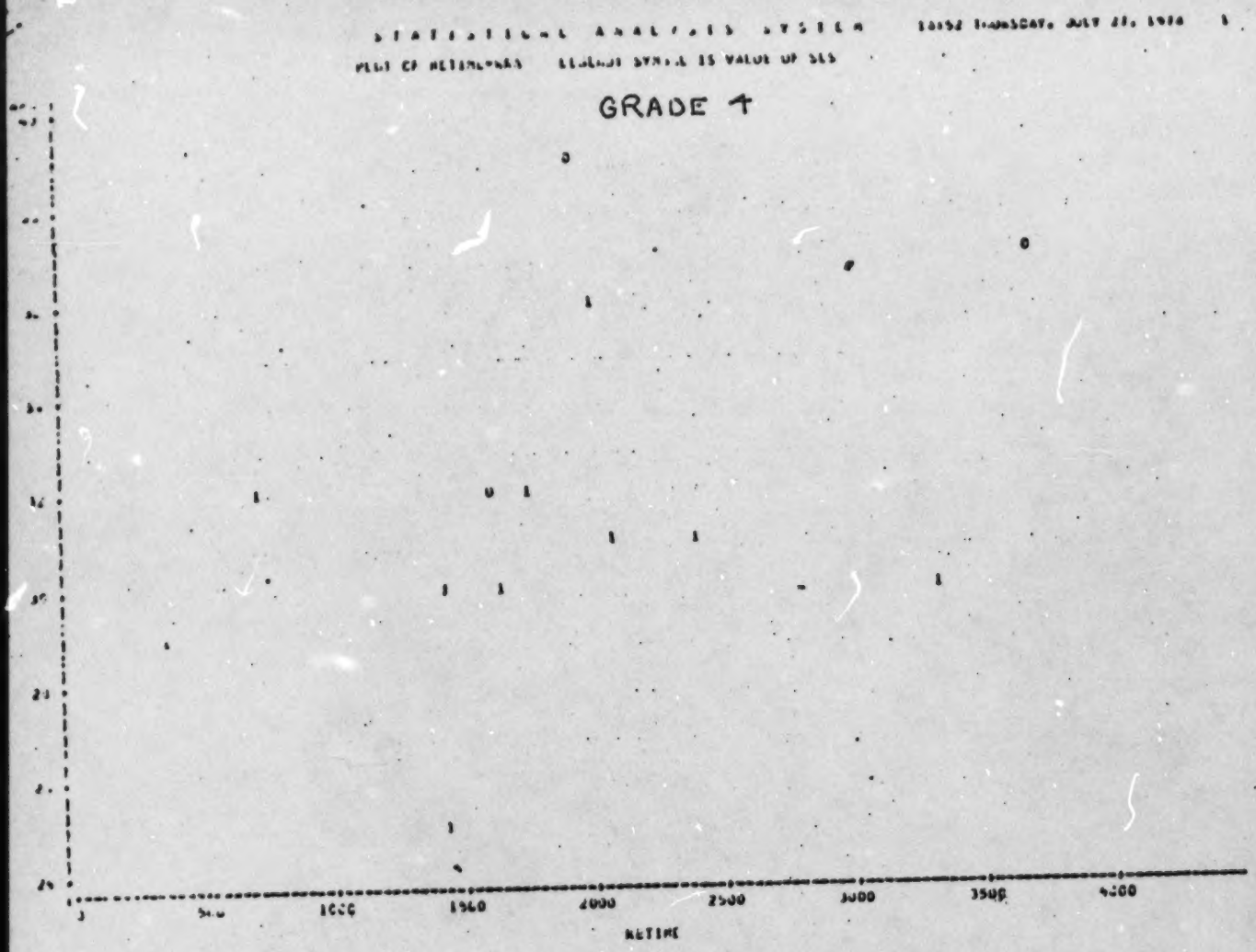

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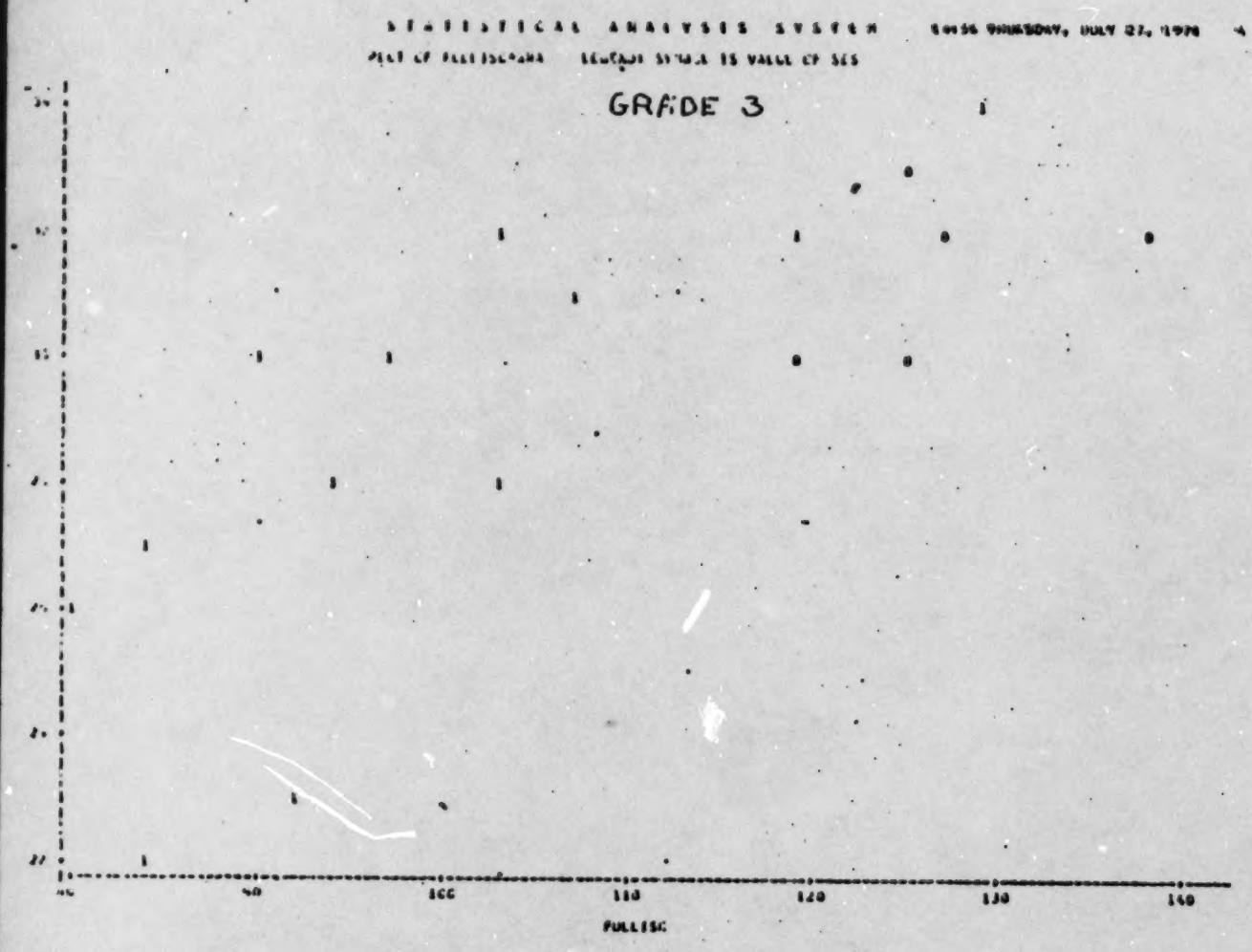

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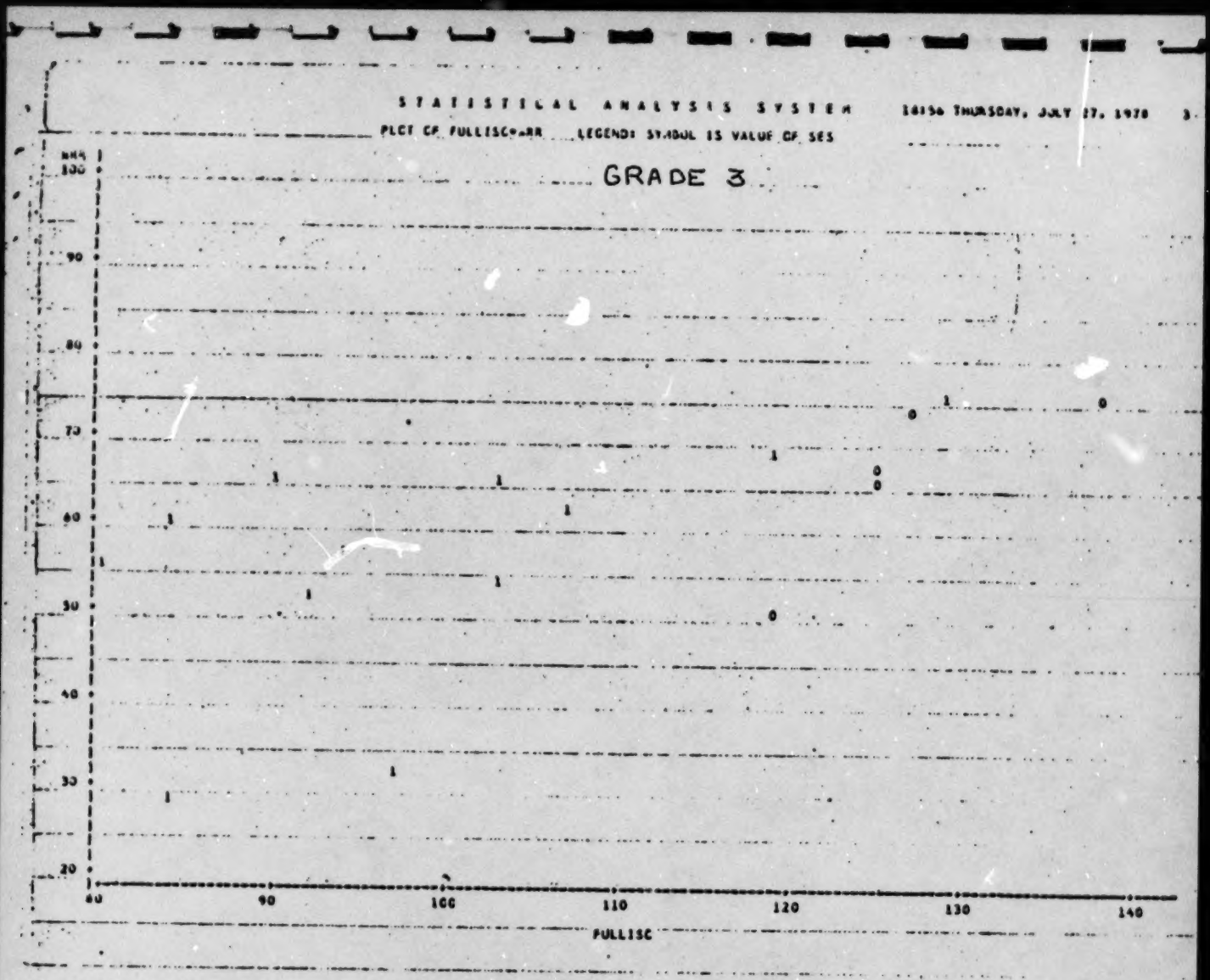

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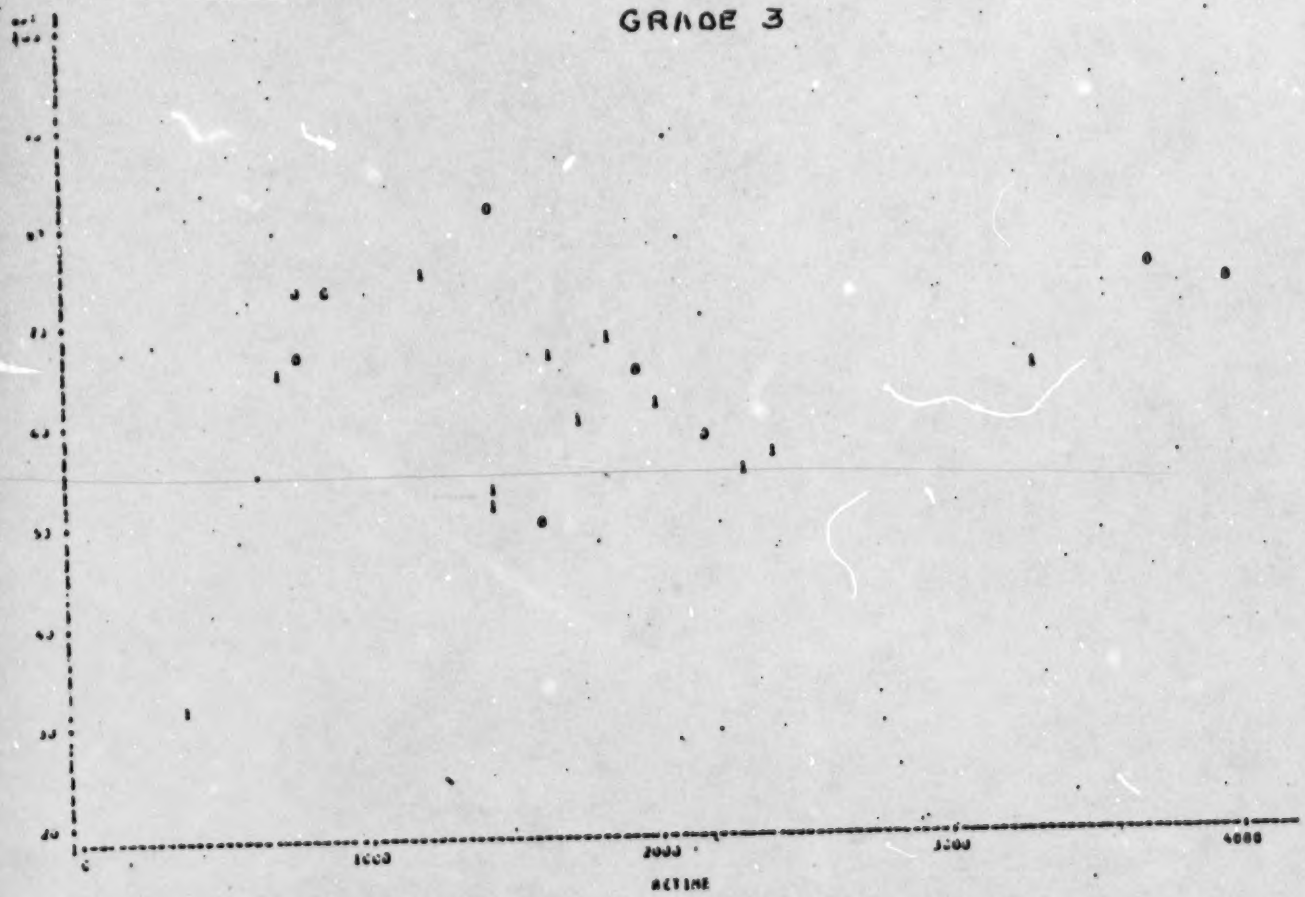
PLOT OF RETARDATA LEGEND: SYMBOL IS VALUE OF SEX

GRADE 3



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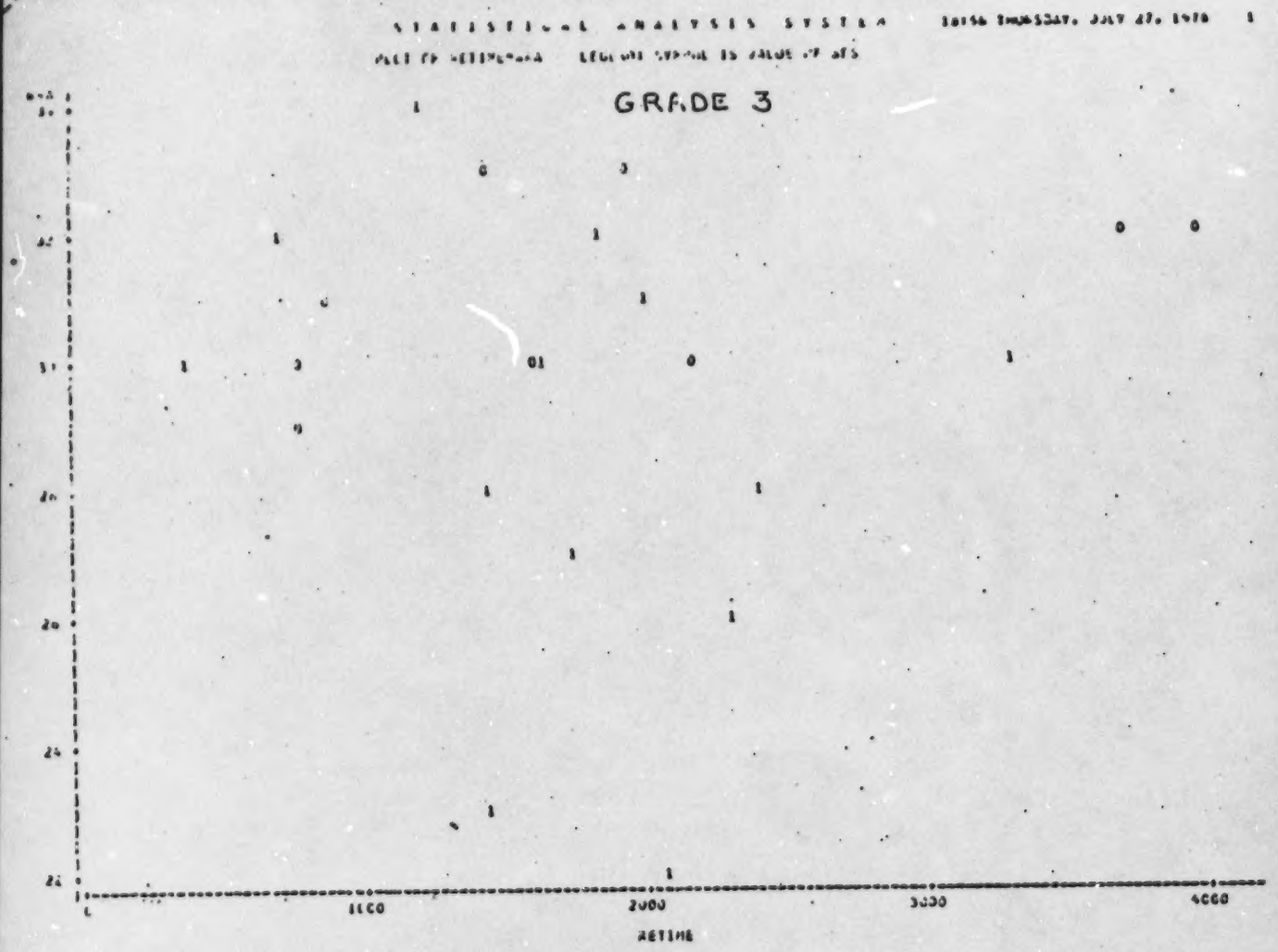

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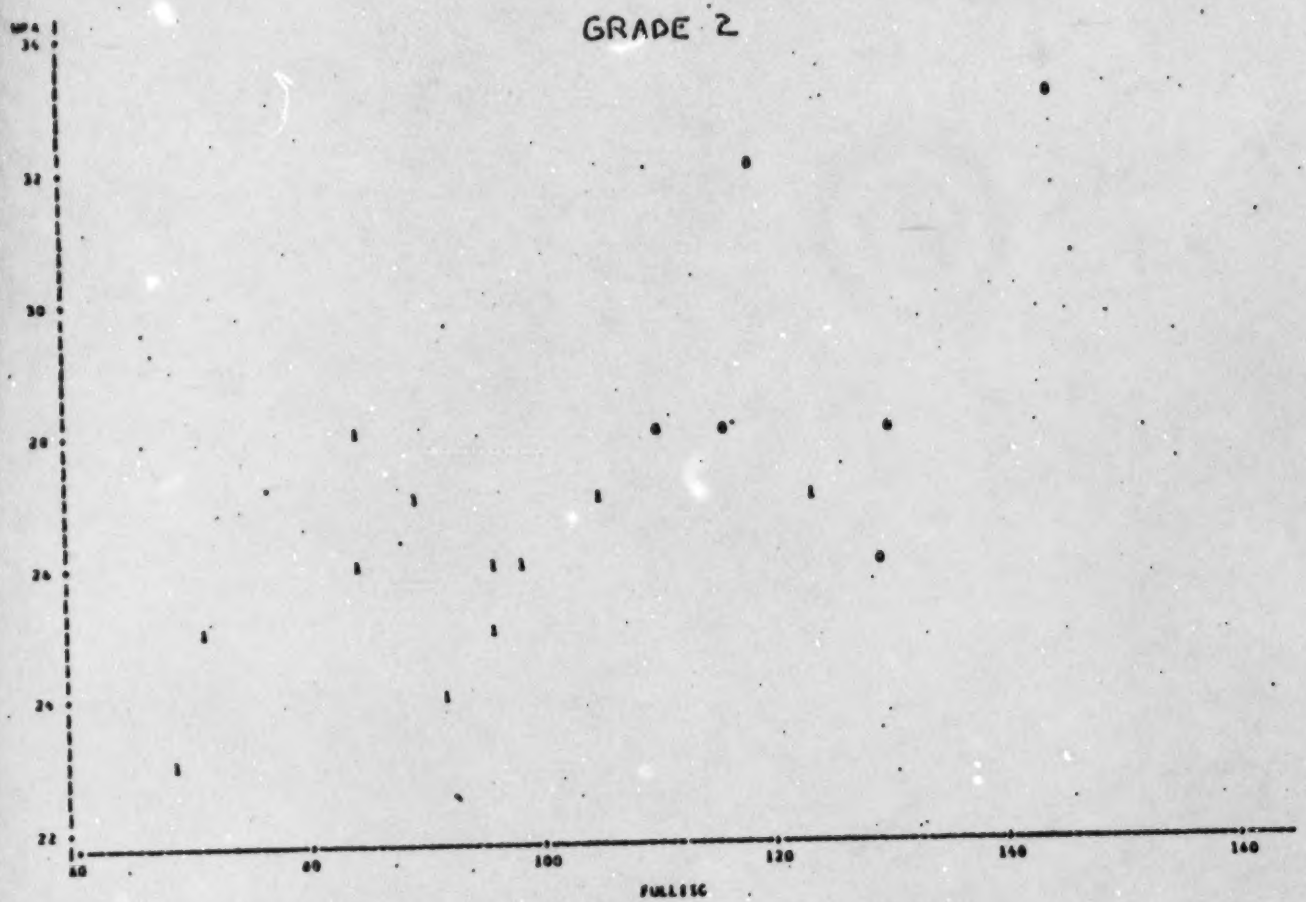
PLOT OF FULLSCORE LEGEND: SYMBOL IS VALUE OF SES

GRADE 2



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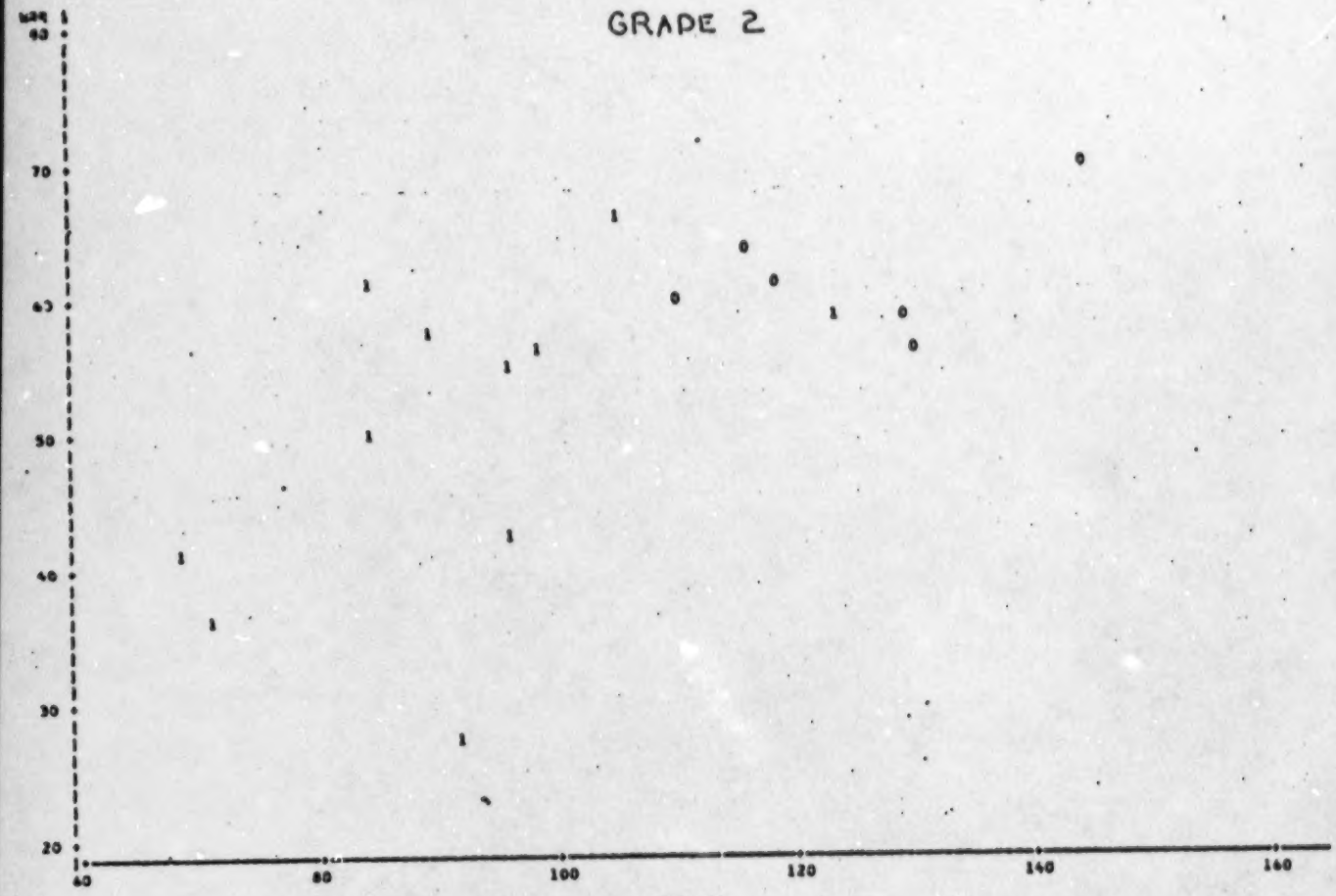
PLOT OF FULLISC*HAR LEGEND: SYMBOL IS VALUE OF SES

GRADE 2



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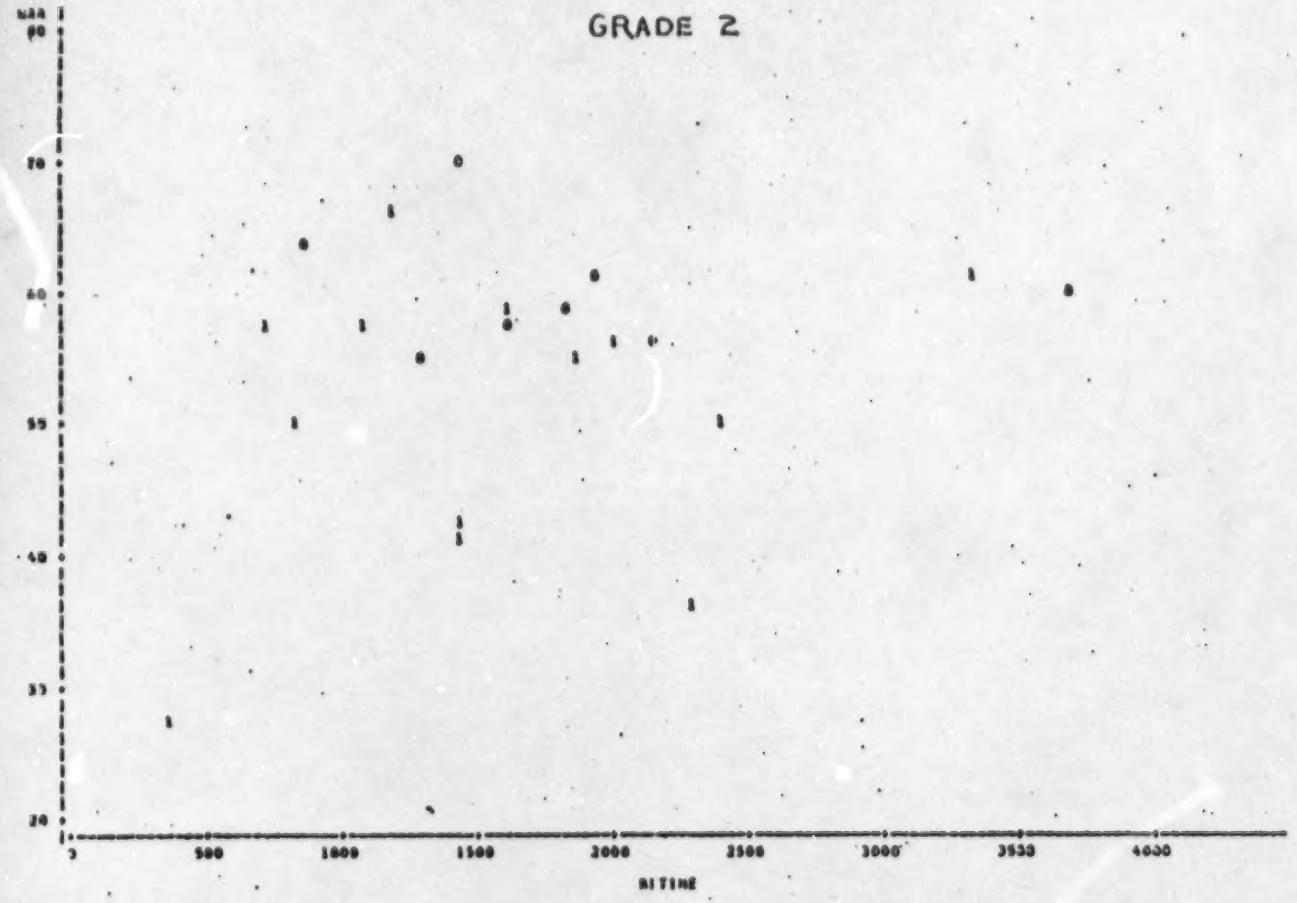
PLOT OF RETIME*HRN LEGEND: SYMBOL IS VALUE OF SES

GRADE 2



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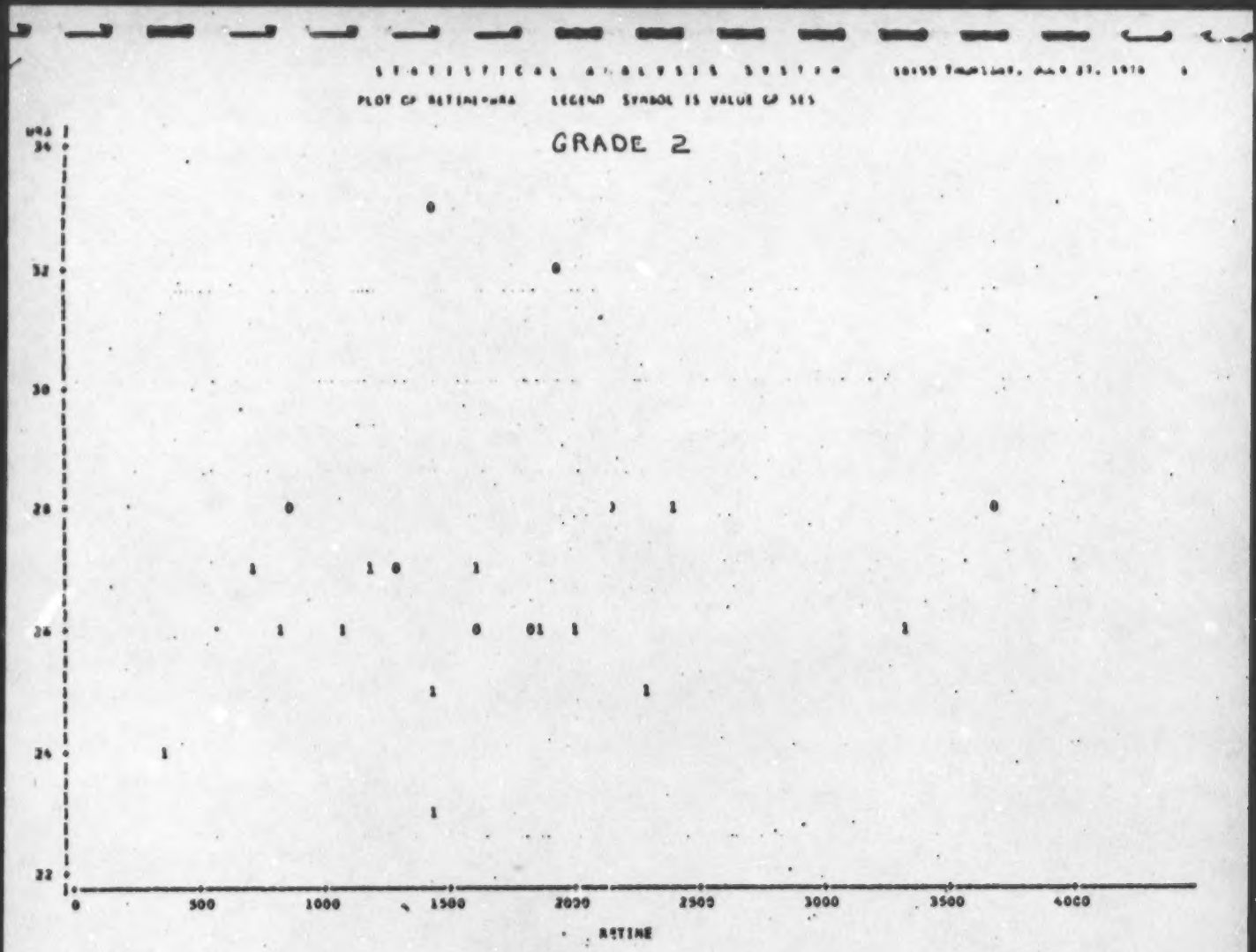

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PLOT OF FULLSC*UMA LEGEND: SYMBOL IS VALUE OF SES

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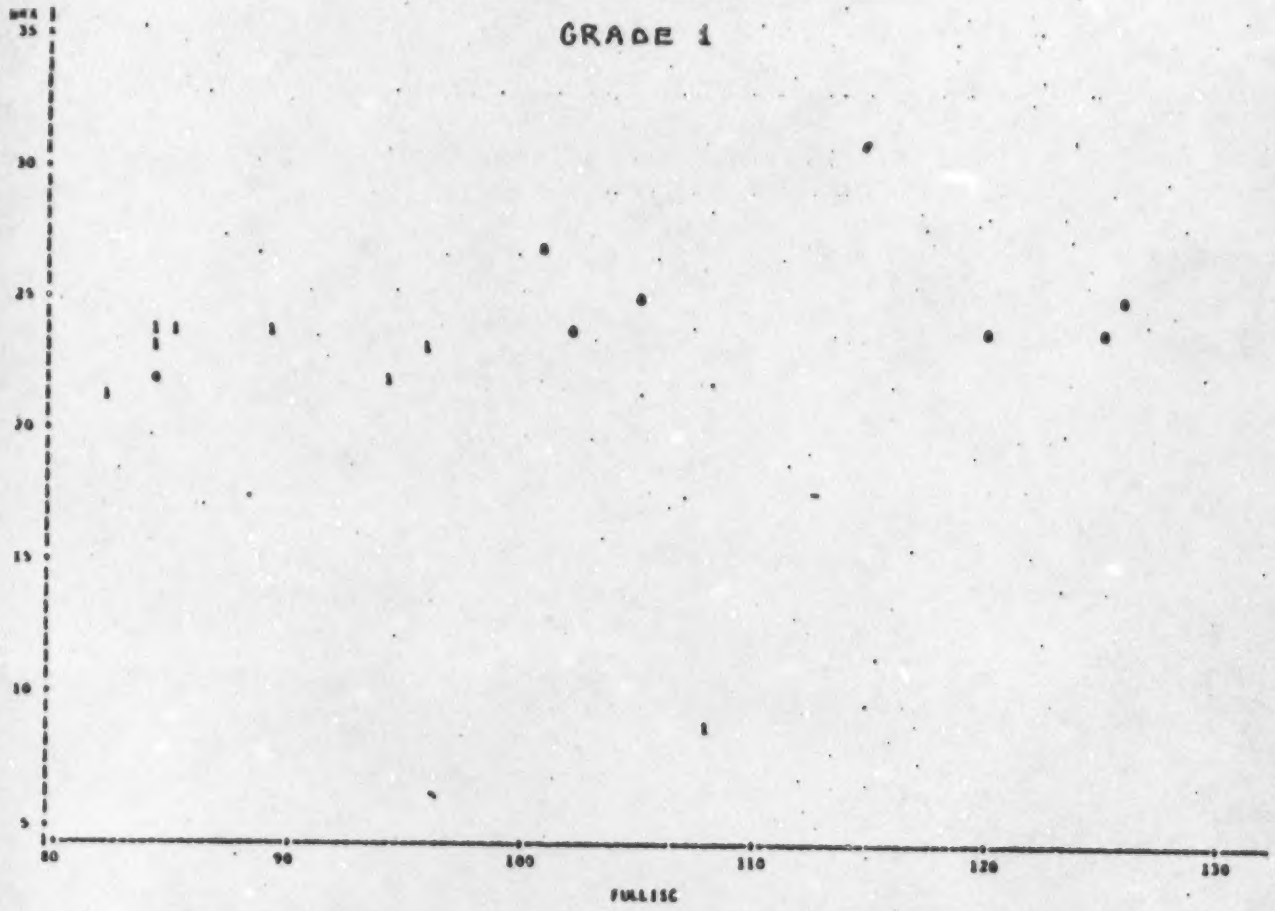

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PLOT OF FULLISC*VRR LEGEND: SYMBOL IS VALUE OF SES

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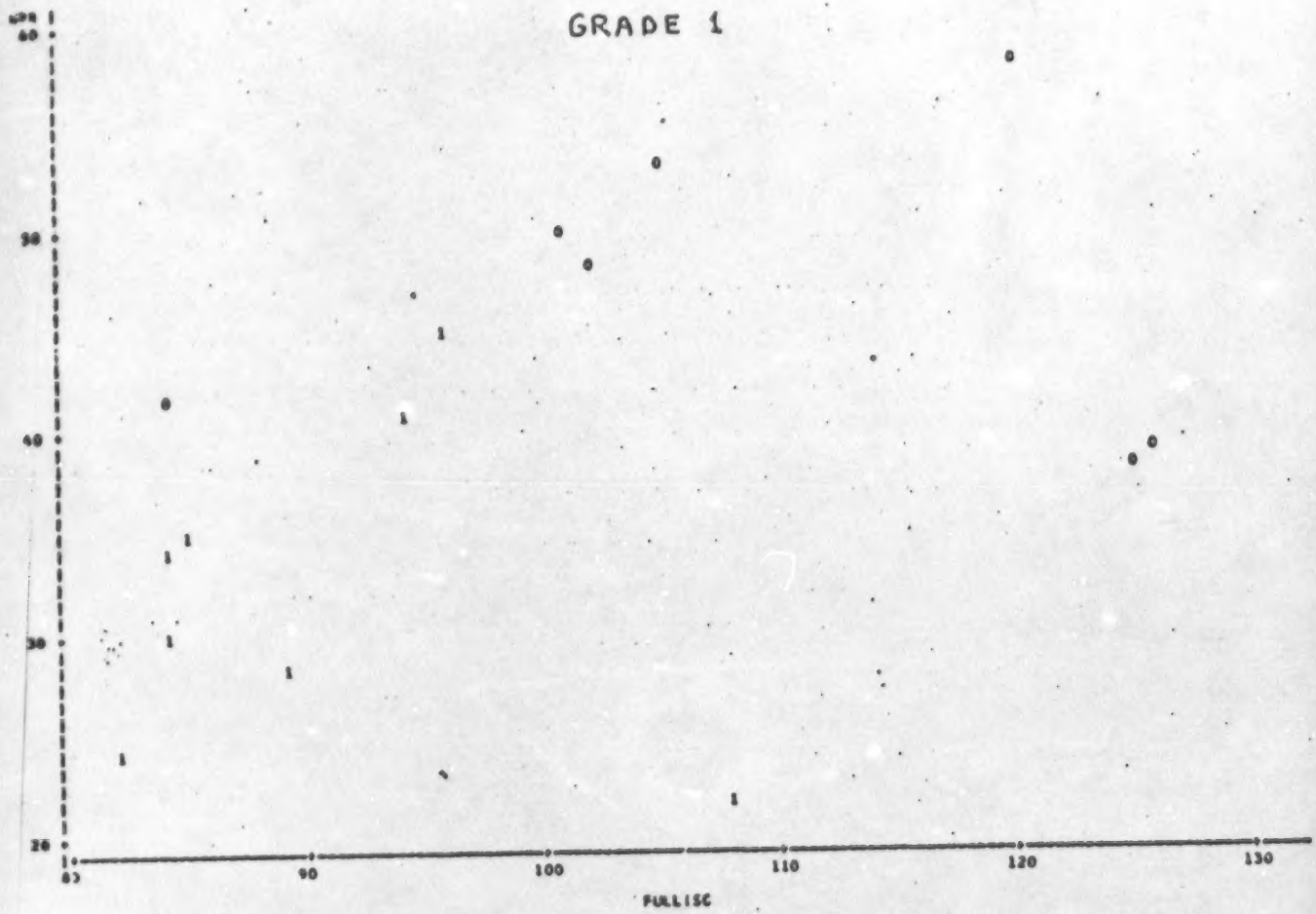

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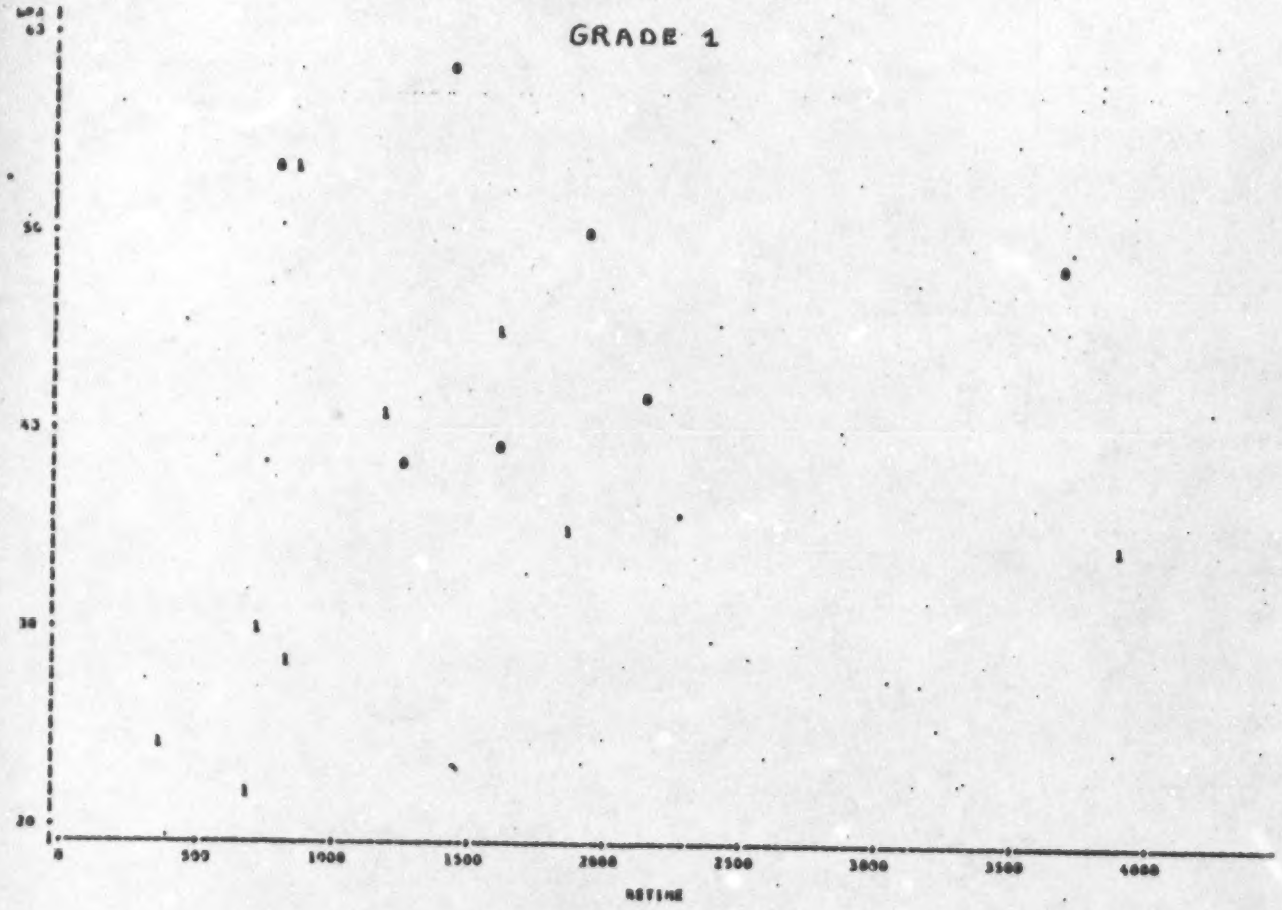
STATISTICAL ANALYSIS SYSTEM 18:54 THURSDAY, JULY 27, 1978 2

PLOT OF RETIME*VAR LEGEND: SYMBOL IS VALUE OF SES

GRADE 1



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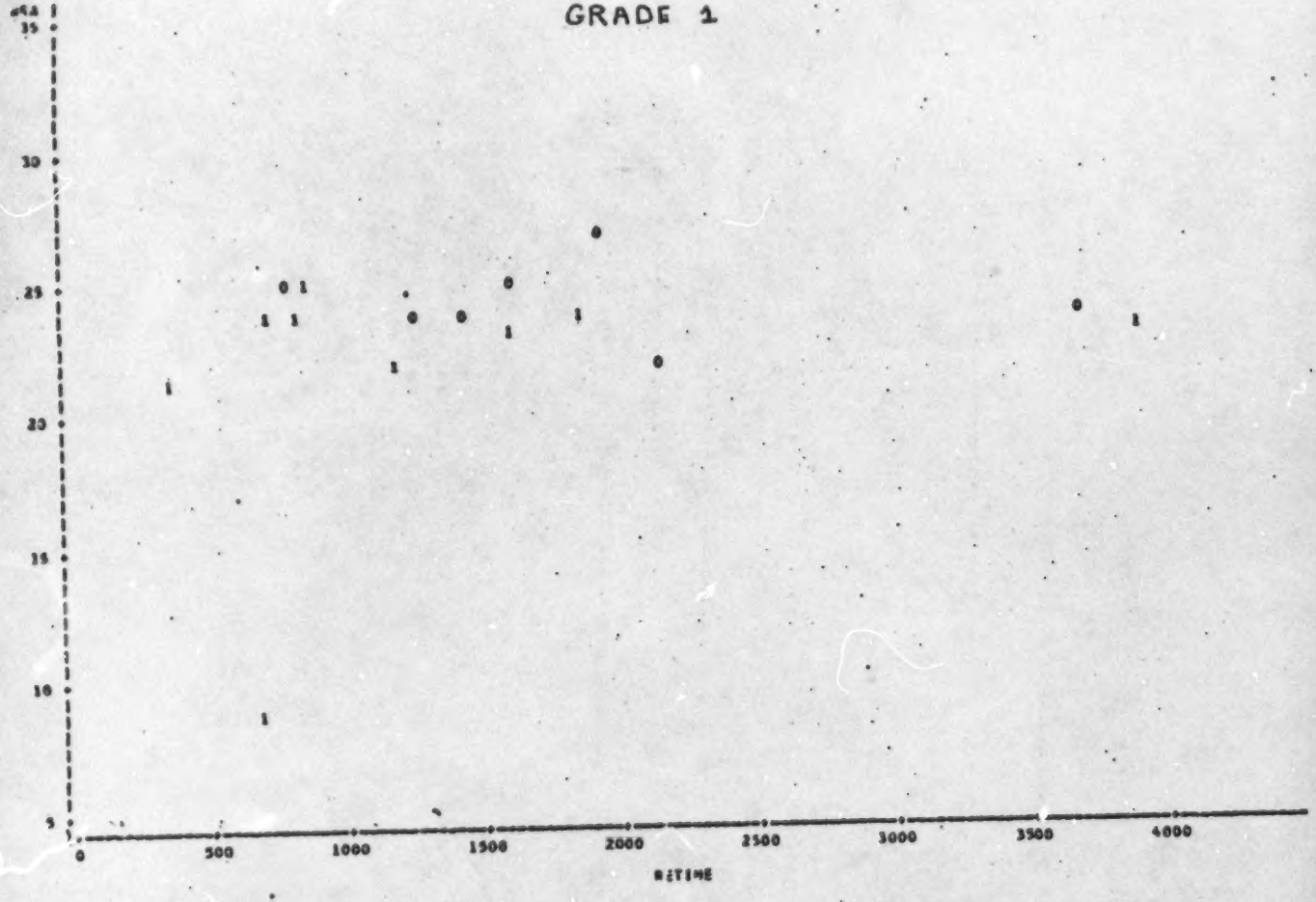
STATISTICAL ANALYSIS SYSTEM 10:54 THURSDAY, JULY 27, 1978 1

PLOT OF RETIME*NRA LEGEND: SYMBOL IS VALUE OF SES

GRADE 1



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Key to Tests Used
in the
Drexel Early Childhood Center Program

Wechsler Intelligence Scale for Children - Revised — WISC-R

The WISC-R is an intelligence test administered individually to children ages 5 to 16. It is designed to assess their overall capacity for intelligent behavior. The individual receives a full-scale IQ score as well as separate verbal and performance IQ scores.

Wechsler Preschool and Primary Scale of Intelligence — WPPSI

The WPPSI is an intelligence test administered individually to children ages 4 to 6½ to assess overall capacity for intelligent behavior. Similar to the WISC-R it has subtests with verbal and performance scales, however they are designed for younger children.

Peabody Picture Vocabulary Test — PPVT

PPVT is a non-verbal multiple choice test designed to provide an estimate of verbal intelligence for children ages 2½ to 18. The Peabody IQ score has been used in this study only for children too young to take the WPPSI.

Frostig — FROSTIG

The Frostig is designed to measure visual perception skills deemed important for later success in reading.

Illinois Test of Psycholinguistic Abilities — ITPA

ITPA is used to obtain indices of auditory perception abilities considered to be important for later reading success.

Wide Range Arithmetic — WRA

The WRA indicates the child's specific competencies in the arithmetic area.

Wide Range Reading — WRR

The WRR is a test of letter and word recognition skills.

Informal Word Recognition — IWR

The IWR inventory is designed to measure a child's independent and instructional levels in reading. It stresses the mechanical rather than content aspects of the reading process.

Spache Diagnostic Reading Scale — SPACHE

The SPACHE combines the mechanical and understanding aspects of reading to determine a child's instructional, independent and frustration levels in reading.

Informal Reading Inventory — IRI

The IRI measures much the same kinds of skills as the SPACHE (see above).

California Achievement Test — CAT
Stanford Early School Achievement Test — SESAT

These are paper and pencil group tests and are norm referenced. They are designed to yield scores which give a child's relative status in relation to his peers.